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PRESENT CHANGES AND PREDICTIONS FOR FISHERY AND MARICULTURE IN THE EASTERN ADRIATIC (CROATIA) IN THE LIGHT OF CLIMATE CHANGE

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ABSTRACT

Over the past decade, the waters of the Croatian Adriatic Sea have been marked by significant changes in the characteristics of the marine ecosystem. Although a link between these changes and the common explanation of climate change has not been scientifically proven, the effects of the changes are already clearly evident. This includes the effects on the fisheries and mariculture sectors through the invasion of new fish species, better performance of native warm-water species and significant pressure on cold-water species. As some of the recent effects have clear economic consequences for the fisheries, this paper provides an overview of the impact of climate change as well as predictions for future management strategies for the Croatian fisheries and mariculture sectors.

Key words: Climate change, Adriatic Sea, Croatia, fishery, mariculture

CAMBIAMENTI ATTUALI E PREVISIONI PER LA PESCA E LA MARICOLTURA NELL'ADRIATICO ORIENTALE (CROAZIA) ALLA LUCE DEL CAMBIAMENTO CLIMATICO

SINTESI

Durante il decennio scorso nelle acque adriatiche croate sono stati riscontrati cambiamenti significanti delle proprietà degli ecosistemi marini. Sebbene il legame tra questi mutamenti e la spiegazione comune del cambiamento climatico non sia stato scientificamente provato, gli effetti dei mutamenti sono già evidenti. Gli autori rilevano gli effetti sulle attività di pesca e maricoltura attraverso l'invasione di nuove specie ittiche, con adattamenti migliori di specie provenienti da acque più calde e una forte pressione sulle specie di acque più fredde. Poiché alcuni degli effetti più recenti hanno evidenti conseguenze economiche sulle attività di pesca, l'articolo fornisce un esame degli impatti dei cambiamenti climatici, nonché le previsioni per le future strategie di gestione per la pesca e la maricoltura croate.

Parole chiave: Cambiamenti climatici, mare Adriatico, Croazia, pesca, maricoltura

INTRODUCTION

As a country with a large coastline and thousands of islands, Croatia has developed fishing and mariculture industries that are important to its economy, especially in those coastal areas and on islands where other economic activities, except tourism, are limited (Katavić, 2004).

Climate change is becoming more evident. As it intensifies, it will alter the productivity of the fisheries and the distribution of fish stocks (Daw *et al*., 2009). From an economic point of view, such changes will impact the fisheries and coastal communities differently. These expected changes require adaptable and flexible fisheries, aquaculture management policies and governance frameworks. However, the form of climate change and the extent of its impacts remain uncertain. Therefore, under such uncertainty, fisheries policy makers need to develop strategies and decision-making models in order to adapt to climate change while taking into account the social and economic consequences. The physical and biological effects of climate change are increasingly becoming better understood, particularly for well-studied temperate shelf ecosystems (Barange & Perry, 2009). However, relatively little is known of the likely climate change impacts on other ecosystems and their associated fisheries (Glamuzina, 1999). In general, climate change indeed appears to be having an impact on fish ecology and fisheries but the strength and direction (both positive or negative) of the effects vary from place to place. The social and economic effects of climate change are less clear; however, it is likely that the economies of countries with the lowest levels of adaptive capacity will be most vulnerable to the effects of climate change and less able to anticipate and capitalise on any climate change induced advantages that may arise (Dulvy *et al*., 2011).

Changes in the sea temperature may make some fish and shellfish more susceptible to diseases or make the water inhabitable (De Silva & Soto, 2009). Other marine species may be affected by new invaders, either through food web changes or pressure on habitats. Finally, the ecological makeup of the sea may change, creating opportunities for new commercially viable fisheries and necessitating changes in the marketplace.

This paper will examine the potential threats and opportunities for fishery and mariculture in the Eastern Adriatic (Croatia) as brought about by climate change, and make recommendations for moving forward in addressing climate change.

THE IMPORTANCE OF THE FISHING AND MARICULTURE SECTORS TO CROATIA

Even though the fishery and mariculture sectors account for a relatively small share of Croatia's GDP, they play an important role in the socio-economic status of a large number of people. More than 20,000 are directly employed in the commercial Croatian fishery sector, with the number of commercial fishermen tending to hold relatively steady throughout the years. Currently, 70 % of fishing, mariculture and processing activities take place on islands, where income sources are limited; thus, this activity is important for development in areas that are economically vulnerable. At the regional level, mariculture is an important industry in the Zadar and Dubrovnik counties. In some regions, fisheries, particularly fish farming, is strongly linked to the development of rural tourism. Fish also represents a source of high-protein food, which is an important element of human nutrition in vulnerable coastal-based communities.

The Croatian fishery is multispecies oriented. There are 444 fish species presently living in the Adriatic Sea (Lipej & Dulčić, 2010), more than 100 of which are commercially exploited (Cetinić & Soldo, 1999). In 2009, the total catch of marine fish and other marine organisms amounted to more than 53,596 tonnes. Small pelagic fish predominate (49,459 tonnes), which mainly comprise fish destined for fish-processing plants and for the feeding of farmed tuna (Croatian Chamber of Economy, 2010). Small pelagic fish are also the most common fish consumed in the domestic market. Between 2004 and 2007, the demand for pelagic fish increased at the same rate as overall production (7 %). However, the demand for demersal/bottom-feeding catches has also increased over the last few years. Continuous monitoring of marine resources (Cetinić & Soldo, 1999) has shown that as much as 80 % of demersal catches are composed of only ten species, with the most important being hake (*Merluccius merluccius*), Norway lobster (*Nephrops norvegicus*) and striped mullet (*Mullus barbatus*). This can be attributed to the overfishing of other important demersal fish species.

The total mariculture species production in Croatia in 2009 was 11,300 tonnes, which included 5,000 tonnes of European sea bass (*Dicentrarchus labrax*) and gilthead sea bream (*Sparus aurata*), 4,200 tonnes of tuna (*Thunnus thynnus),* 2,100 tonnes of mussels (*Mytilus galloprovincialis)* and 100 tonnes of European flat oysters (*Ostrea edulis)* (Croatian Chamber of Economy, 2010).

The potential impact of climate change on the Croatian fishery and mariculture sectors is complex since both positive and negative effects can be brought about. These include changes in the marine environment, changes in the migration patterns of fish in the open sea (including migration pressures on cold-water species), potential changes in the growing season and rearing time for farmed fish and a potential increase in invasive species, which has increased catches of new species but threatened the production of others.

EXISTING IMPACTS FROM CLIMATE CHANGE

The abundance of marine fish populations in the Adriatic is already showing significant fluctuations (Dulčić & Grbec 2000; Grbec *et al*., 2002; Dulčić *et al*., 2004). Changes in fish behaviour and migration patterns are also seen in these Adriatic populations, having implications for fish catches (Dulčić *et al*., 2004; Lipej & Dulčić, 2004). The relationship between these fluctuations and large-scale climate change is of great concern.

Previous researches in the Adriatic Sea have shown that the inflow of Mediterranean water into the Adriatic increases productivity in Adriatic waters that otherwise have relatively low nutrient levels (Zore-Armanda *et al.,* 1999). Different biological phenomena have been observed and linked to the stronger inflow of water from the Mediterranean into the Adriatic. In addition, the temperature and salinity properties of the water (*i.e.* its thermohaline properties) have been shown to have impacts on phytoplankton and fisheries (Zore-Armanda *et al.,* 1999). In general, the level of fish biodiversity in the Adriatic Sea generally increases from north to south. While there is a range of factors that may affect this pattern, the main factor appears to be temperature. Already, research has shown a large northward expansion of fish species that are more suited to warmer waters (Glamuzina & Skaramuca, 1999; Dragičević & Dulčić 2010) (Fig. 1). This indicates a change in marine biodiversity, as numerous fish species that previously lived in southern areas are moving northward. Numerous species new to the northern parts of the Adriatic Sea have been recorded over the last thirty years (Dulčić & Dragičević, 2011).

During 1973–2003, a strong correlation was found between the average annual air and sea surface temperatures and the number of species (Dulčić *et al*., 2004). A strong correlation between annual sea surface temperature and the annual total number of fish has also been found. The variations in the Adriatic temperature conditions correlate with the North Atlantic Oscillation (NAO) index, indicating that local temperature changes at least partly result from hemispheric temperature changes. This implies that variations in Adriatic temperature changes are likely to be affected by climate change, since climate change influences the NAO (Grbec *et al*., 2002).

In order to establish the relationship between the hydro-climatic variables and the pelagic species (sardine, anchovy and sprat), year-to-year fluctuations of small pelagic fish landings (*i.e.,* the number of fish that are taken ashore) on the eastern Adriatic coast were compared with climatic fluctuations over the northern hemisphere and salinity fluctuations in the Adriatic (Grbec *et al*., 2002). Using this approach, basic climatic oscillations were determined over a period of approximately 80 years, with which researchers found an correlation between climatic fluctuations over the northern hemisphere and small pelagic fish landings (Dulčić & Grbec, 2000; Grbec *et al*., 2002). Bombace (1992) suggested that the

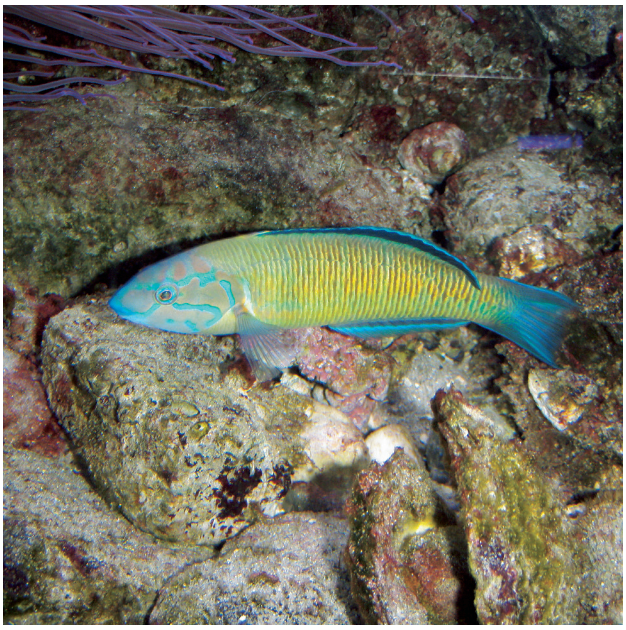

Fig. 1: Rainbow wrasse (*Thalassoma pavo*) is a northward spreading warm-water species. (Photo: B. Mavrič)
Sl. 1: Pavji knez (*Thalassoma pavo*) je značilna vrsta, povezana s segrevanjem morja, ki se širi proti severu. (Foto: B. Mavrič)

fluctuations of small pelagic stocks in the Adriatic Sea may be due to the modifications of the production level in the ecosystem, determined by variations in the river nutrient input. The fluctuation period of 11–12.5 years in the fish landing data can be connected to a major solar activity cycle, which is observed in many biological processes worldwide. All the analysed series – fish species, salinity and pressure differences – have the same fluctuating periods, which indicate a connection to climatic oscillations (Grbec *et al*., 2002). Although the NAO index has the same fluctuation period, there was no significant correlation with it except for the anchovy (*Engraulis encrasicolus*) and sprat (*Sprattus sprattus phalericus*). The sardine (*Sardina pilchardus*), mackerel (*Scomber scombrus*) and anchovy respond to salinity changes, which are modulated by the climate oscillations in the Adriatic, as described by the pressure differences between the mid-north Atlantic and southeast Mediterranean (Grbec *et al*., 2002).

Such long-term variation has been observed worldwide and was considered a normal part of the life cycle of pelagic fish (Dulčić *et al*., 2004). However, the most recent observed changes in sardine populations in the Adriatic Sea include prolonged spawning seasons and spawning in areas that were historically unknown. This change in behaviour can be attributed to global climate change. In other words, climate change is already changing the behaviour and migration patterns of pelagic fish in the Adriatic.

Other categories of biological response include the changed migration patterns of sprats and the drastic collapse of the European anchovy stock since 1995. Mass mortalities of round sardinella were recorded along the Apulian and central Croatian coasts in January 2002, when an abrupt fall in seawater temperatures occurred (Guidetti *et al*., 2002). This fish is a warm-water species that was recorded for the first time along the Croatian coast 40 years ago. As this fish is not yet commercially utilised in Croatia, this event did not have any commercial influence on the fishing sector. Furthermore, this event did not have any impact on the native species.

FUTURE IMPACTS: TEMPERATURE CHANGES

Climate change-related warming may have the following impacts on the Croatian fishing sector:

- Due to accelerated biological processes at all levels of marine ecosystems, the growth rate of fish should be higher and reproduction seasons should be longer for most species. As a result, the recruitment of species that thrive in warm water should be significantly improved.
- The opposite will likely occur with species that thrive in cold-water, such as Norway lobster (*Nephrops norvegicus*). These species will migrate to colder areas, either horizontally (north, south, east, or west) or vertically (to deeper levels).
- Temperature increases will heighten the risk of depleted oxygen levels in the shallow areas of the Adriatic. This situation will create conditions that allow for an increase of species that tolerate warm water and lower oxygen levels (Fig. 2).
- The introduction of new disease organisms or exotic and undesired species will likely occur due to increased sea surface temperatures.
- Tuna (*Thunnus thynnus*), which is the most important economic product within the fishery and mariculture sectors, is a typical warm-water species. Tuna farming, as it is currently practiced in the Eastern Adriatic, will likely benefit from climate change due to higher growth rates resulting from more intensive feeding and a higher feed conversion index.

In general, it is likely that there will be an increased potential for aquaculture, which would yield a positive impact. The increase in the sea surface temperatures in the winter as a consequence of climate change might create favourable conditions for the growth of marine organisms during this season. Therefore, rearing times could be shorter and aquaculture production could become more efficient.

The influence of climate change on species presently under mariculture in the Eastern Adriatic should be generally positive, due to a prolonged growing season and a shortening of rearing cycles. This particularly applies to two species: the gilthead sea bream (*Sparus aurata*) and the Mediterranean mussel (*Mytilus galloprovincialis*). These two species are better adapted to higher temperatures and thus will tend to benefit from a rise in Adriatic water temperatures. The only potential problem here involves the reproduction period of mussels, during which freshwater inflow is required; this inflow could be limited due to lower precipitation levels in the area. This will be especially important during the summer months, when precipitation levels on the coast are expected to drop by up to 39.3 % in the summer months in Dalmatia (UNDP, 2009).

The situation with two other species – sea bass (*Dicentrarchus labrax*) and the European flat oyster (*Ostrea edulis*) – is different due to the fact that they generally prefer colder water. Current situations in Greece and Turkey regarding these species are applicable to the future conditions of the Croatian coastline. In Greece and Turkey, sea bass farming is not dominant due to warmer water and the associated susceptibility to disease (Stephanis, 1995). Presently, sea bass farming operations in the Eastern Adriatic are among the best in the Mediterranean due to excellent water conditions, which include lower temperatures. Temperature increases will confront Adriatic growers with conditions similar to those that were previously faced by Greek growers; the result will likely be a necessary shift to gilthead sea bream, a species that is tolerant to higher temperatures. Alternatively, the sea bass cages will have to be moved to colder zones or deeper nets up to 10 m in depth will need to be used. This would substantially increase the costs of sea bass production.

The scenario for sea bass is similar to that for the flat oyster. The dangerous or lethal temperature for the flat oyster is 26 °C, which has already been measured along

Fig. 2: Would the populations of some edible crustaceans face a decline due to higher temperatures and oxygen depletion in the bottom layer? (Photo: B. Mavrič)
Sl. 2: Bodo zaradi višjih temperatur v pridnenem sloju in slabših kisikovih razmer upadle populacij nekaterih užitnih rakov? (Foto: B. Mavrič)

the coastline and in the traditional culture grounds of Mali Ston Bay (Bratoš *et al*., 2002). Events of summer mortality of the flat oyster in some areas of the Mali Ston Bay have already been reported. As the Integrated Developmental Strategy of Mali Ston Bay (Glamuzina, 2009) calls for a significant increase in the production of this lucrative species, water temperature increases will be one of the major future obstacles in long-term planning for this area. As with sea bass, production should be transferred to deeper water during the critical summer months as the sea temperatures rise; as before, new costs are associated with this. For most farms, this should only entail the simple addition of a few metres of rope; however, for farms situated in shallow water, this change will involve completely moving the production site. While this is not a complicated adaptation measure, it will certainly increase the costs of flat oyster production. However, the flat oyster should receive a benefit similar to the mussels – a prolonged growing season, an earlier and longer reproduction season and a reduction in the time of the rearing cycle.

In general, the effects of climate change on shellfish cultures appear to be positive but some changes in culture practice would be necessary.

FUTURE IMPACTS: INVASIONS OF NEW SPECIES

Since fish respond to warming by migrating, they may be a useful index of the effects of warming in the Adriatic. The incoming northwestward current along the eastern Adriatic coast carries food and plankton and makes the entrance of species from southern areas more likely. The northward spread and increase in abundance of the southern fish species occurs in several phases. At first, only a single adult appears. Subsequently, more adult individuals are observed. Reproduction then begins and larval and juvenile stages occur in the area. Finally, the southern species achieves the status of a new settler. It can be concluded with certainty that, within the Adriatic Sea, warm-water species are extending their range northward. Two factors may be causing this migration: 1) demographic expansions, which affect individual species, and 2) climatic fluctuations, which shift the bio-geographical boundaries (Fig. 3).

Historical temperature data and hydrological information favour the second hypothesis. Examples of invasive species in the Adriatic Sea include the following: the common dolphinfish (*Coryphaena hippurus*), the grey triggerfish (*Balistes capriscus*), the bluefish (*Pomatomus saltatrix*), the parrotfish (*Sparisoma cretense*), the round sardinella (*Sardinella aurita*), the Atlantic lizardfish (*Synodus saurus*), the Atlantic pomfret (*Brama brama*) and the European barracuda (*Sphyraena sphyraena*) (for a comprehensive review, see Dragičević & Dulčić, 2010; Dulčić & Dragičević; 2011). Some of these species, such as the bluefish, can affect local fisheries due to having a significant impact on the food chain. In the Adriatic,

Fig. 3: Terapon (**Terapon theraps*****) is a Lessepsian migrant, recorded in the Adriatic Sea. (Photo: B. Mavrič).***
Sl. 3: Terapon (**Terapon theraps*****) je lesepska selivka, ujeta v Jadranskem morju. (Foto: B. Mavrič)***

bluefish feed mainly on mullet and anchovies. At the same time, bluefish could be treated as an alternative species in local fisheries. Here, four categories of biological response to climate change can be distinguished: the appearance of indicator species, the appearance of new populations, the increase or decrease of fish stocks based on year-class strength and structural changes in the ecosystem, including demographics of fish populations and interactions within food chains (Lipej & Dulčić, 2004).

Species introductions into the Adriatic Sea have not yet been systematically studied although current data implies the existence of new species. The settling of new species in the environment has caused a generally progressive decline in biodiversity but at present there are no studies regarding the impact on the diversity of fish species. Over the past century, the northern hemisphere's average surface air temperature has increased by about 0.6 °C, while at over the same time period the northern Adriatic air temperature increased by 0.79 °C (Grbec *et al.,* 2008). Since the beginning of recording of temperatures, the 1990s was the warmest decade ever and 1998, 2000, 2002 and 2003 were the four warmest years (Grbec *et al*., 2008). There is considerable year-to-year variability in the sea surface temperatures for the Adriatic stations of Dubrovnik, Split and Trieste. Based on the long-term mean for the period 1961–2004, the two most recent warm periods in the Adriatic were 1985–1987 and 1990–1995, for which there were positive temperature anomalies of 0.15 °C and 0.30 °C respectively (Grbec *et al.,* 2008). Most of the new occurrences of species were recorded during these two periods. This indicates that when the water is warmer, fish migrate and new species invade the Adriatic (Dulčić *et al*., 2004; Dulčić & Dragičević, 2011).

Extensive research has been carried out concerning the phenomenon of species migration in and from neighbouring ecosystems. After the construction of the Suez Canal between the eastern Mediterranean and

the Gulf of Suez in 1869, hundreds of Red Sea and Indian Ocean species traversed the channel and settled in the Mediterranean (Streftaris & Zenetos, 2006). This process is known as the Lessepsian migration and is considered to have been an important factor in the increase of Mediterranean fish diversity. Thirteen migrant Lessepsian fish species were recently recorded in the Adriatic Sea (Dulčić & Dragičević, 2011). Again, temperature is the most important non-biological factor in determining the dispersal of Lessepsian fish. Although the detailed impact of the Lessepsian migrants on the Adriatic environment is still not fully known, some of the newcomers could potentially affect the environment, since a few of them have established populations in the Adriatic (such as *Fistularia commersonii* and *Saurida undosquamis*). Their rapid spread throughout the Adriatic, followed by rapid population increases in invaded areas, could have impacts on the local fish populations (Dulčić *et al*., 2008).

CASES OF INVASIVE SPECIES IN THE EASTERN ADRIATIC

The impact of previously-introduced new species in the Adriatic Sea has been mixed from an economic standpoint and highly troubling from an environmental standpoint, with significant threats to both commercial and non-commercial indigenous species. Groupers and bluefish provide two examples where the effects on fish populations and the industry have been mixed or wholly negative.

Groupers were rare in the Southern Adriatic and not at all present in the Middle and Northern Adriatic before the 1990s. In the 1990s, they began to propagate and migrate, first migrating as bigger adults and then establishing populations. Several additional grouper species have been identified for the first time in the Middle and Northern Adriatic in the last ten years (Glamuzina *et al*., 2000, 2002). The overall impact on commercial fishing has been positive: they are lucrative, marketable fish. However, from a biological and ecological standpoint, the effect has been negative; the abundance of some native species is now significantly lower due to competition with groupers for food and hiding places (Glamuzina & Skaramuca, 1999).

While the invasion of groupers had a positive economic impact, the invasion of bluefish did not. Bluefish were first recorded in 2004 in the Northern Adriatic, where it was unknown to fishermen (Dulčić *et al*., 2005). The bluefish is a typical predator species, preying mainly on grey mullets. This species also appeared several years ago in the Neretva River estuary, where grey mullet fisheries are the most important segment of the fishing industry. In only a few years, the bluefish had decimated the grey mullets in the area. They also destroyed the nets adapted to the traditional grey mullet fishery. In the meantime, fishermen failed to develop techniques to effectively catch the bluefish. As a result, the current condition of the traditional grey mullet fishery is close to collapse, while any economic benefits that may have been gained by catching bluefish have been ignored. In fact, most suggestions for addressing this crisis focus on eradicating the bluefish by any means possible (Glamuzina & Bartulović, 2010).

CASE OF BLUE CRAB *(CALLINECTES SAPIDUS)* IN THE NERETVA RIVER ESTUARY

This species originates from the western Atlantic and is considered an invasive species in the Mediterranean (Streftaris & Zenetos, 2006). Since it was first recorded in the Mediterranean (in the Northern Adriatic, Venice Lagoon), this species has been widely found in different Mediterranean regions, especially in the eastern areas (Galil *et al*., 2002). Several records have been published in recent years with regard to this species' distribution in the Adriatic (Scaravelli & Mordenti, 2007; Onofri *et al*., 2008), relating its expansion to the increase in maritime transportation. The first specimen at the Parila Lagoon (Neretva Estuary) was caught in 2004. In the following five-year period, this crab established a strong population in the lagoon and potentially presented new lucrative species for the local fishery (Dulčić *et al.,* 2011). Paradoxically, monitoring activities in the area during the summer of 2011 showed a complete disappearance of blue crab in the Parila Lagoon. Some specimens were caught in northern coastal areas, however; hence, we suppose that the whole population migrated to the northern coastal areas. Although this has not been scientifically verified, this confirms the complexity of the behaviour of new species and the uncertainty of any prediction.

POTENTIAL SOCIO-ECONOMIC IMPACTS OF CLIMATE CHANGE ON FISHERIES AND MARICULTURE

Changes in the distribution of fish species in the Adriatic will result in revenue changes for the fisheries sector, with the benefits and losses not necessarily being distributed equally. The invasive species provide an instructive example. The destruction of the grey mullet population in the Neretva Estuary by bluefish represented an acute economic loss for the artisanal fishermen. On the other hand, reductions in the populations of some coastal fish due to the arrival of groupers were offset by the ability to catch and sell this newer invasive species, resulting in a net economic benefit. However, due to the illegal marketing of these lucrative species, it is hard to estimate the present revenue loss or benefit in both of these cases. These examples also indicate the importance of adaptive capacity. In the case of the groupers, the fishing sector was able to adapt to the arrival of the new species by catching and selling it. In the case of the bluefish, the inability to commercially capitalise

on its presence meant that the loss in the grey mullet population was not offset by any new revenue.

The observed changes in habitat also affect the revenues in the fishing sector. Species that thrive in cold-water will require more expensive fishing or farming methods or may vacate their current habitats. Species that thrive in warm water will have a longer growing season and may grow more quickly. Again, these are relationships that remain to be quantified both in terms of magnitude and in terms of revenue gained or lost. The location of the fishing sector along the coastline and on islands where there are very limited opportunities for employment means that the fishing sector may be particularly vulnerable to climate change.

Institutional problems could also affect individuals in the industry. For example, poor economic performance in the sector and a failure to modernise could threaten to close down enterprises and increase the unemployment rate. The decrease in employment will hinder the development of coastal and island rural areas, which depend significantly on these sectors.

ANALYSIS OF AVAILABLE TECHNOLOGICAL OPTIONS FOR ADAPTATION

The available technological options to deal with the impacts of climate change on the fisheries and mariculture sectors can be found in the neighbouring countries already affected by warmer climates, particularly Turkey and Greece. Their experiences in fishing techniques and catching invasive species should be transferred to local Adriatic conditions. Their experiences in growing sea bass and sea bream under warmer conditions should also be used to prevent similar problems in the Croatian mariculture economy.

Policies should be developed and measures applied in the future that take into account the potential impact of global climate change. This should include the transfer of knowledge from adjacent marine areas where such changes have already occurred. It should also include the strengthening of knowledge about fundamental biological and ecological changes under new environmental conditions. For example, it is likely that a shift will be necessary from sea bass to gilthead sea bream, a species that is more tolerant to higher temperatures. Alternatively, the cages with sea bass could be moved to colder zones, or deeper nets up to 10 m in depth may need to be used. This will increase the costs of sea bass production, such as purchasing nets or moving cages, but the level of costs is difficult to estimate due to the specificities of each location. As a result of these activities, adaptive fishery management should be established, which will involve all fishery sectors including scientific institutions, governmental organisations and bodies and individuals within the fishing community.

Additionally, in areas where new species have negative impacts on the overall performance of the fishing industry, compensation mechanisms or intervention strategies should be proposed. These strategies could include the following measures: compensation for net damages made by invasive species such as bluefish, the purchasing of new fishery tools for the fishing of new species, the eradication or population control of the most dangerous invasive species and education of the fishing community regarding the potentials and threats of new fish species.

In conclusion, the fishery and mariculture sectors are likely to face challenges due to climate change but will also be provided with some opportunities to expand production and increase competitiveness. Knowledge concerning the impacts of of climate change should be transferred to actors within the relevant sectors in order to ensure that opportunities are exploited and threats minimised.

TRENUTNE SPREMEMBE IN PROGNOZE NA PODROČJU RIBIŠTVA IN MARIKULTURE V VZHODNEM JADRANU (HRVAŠKA) V LUČI PODNEBNIH SPREMEMB

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POVZETEK

V zadnjem desetletju so za hrvaški del Jadranskega morja značilne pomembne spremembe v značilnostih morskih ekosistemov. Čeprav je zvezo med njimi in običajnimi razlagami podnebnih sprememb še treba znanstveno dokazati, so posledice sprememb jasno opazne na področju ribištva in marikulture. Zaznavamo namreč vdor novih ribjih vrst, boljšo prilagodljivost sredozemskih toploljubnih vrst in povečan stres na hladnoljubne vrste. Glede na to, da imajo nekatere nedavne posledice opazne gospodarske učinke na ribje populacije, smo v članku pripravili pregled vplivov podnebnih sprememb in prognozo, kakšne upravljavske strategije bi bilo v prihodnje treba uvesti na področju ribištva in marikulture na Hrvaškem.

Ključne besede: podnebne spremembe, Jadransko morje, Hrvaška, ribištvo, marikultura

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CONFIRMED OCCURRENCE OF CUCKOO WRASSE *LABRUS MIXTUS* (OSTEICHTHYES: LABRIDAE) IN TUNISIAN WATERS (CENTRAL MEDITERRANEAN)

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ABSTRACT

In this paper the authors report the capture of two specimens of cuckoo wrasse Labrus mixtus *in northern Tunisian waters: a male and a female, both large-sized adults. These captures confirm the occurrence of the species in the area although locally it is considered to be very rare. The origin of both specimens remains questionable, in terms of whether they are indigenous or non-indigenous species: in the latter case eastern Atlantic origin cannot be excluded.*

Key words: Osteichthyes, Labridae, *Labrus mixtus*, Tunisian waters, central Mediterranean

PRESENZA CONFERMATA DI TORDO FISCHIETTO *LABRUS MIXTUS* (OSTEICHTHYES: LABRIDAE) IN ACQUE DELLA TUNISIA (MEDITERRANEO CENTRALE)

SINTESI

Nell'articolo gli autori riportano la cattura di due esemplari di Tordo fischietto, Labrus mixtus, *nelle acque della Tunisia settentrionale. Si tratta di un maschio ed una femmina, due adulti di grandi dimensioni. Tali catture confermano la presenza della specie nell'area, benché localmente venga considerata piuttosto rara. L'origine dei due campioni resta discutibile, in quanto non è possibile stabilire se appartengano ad una specie indigena oppure alloctona. In quest'ultimo caso non si può escludere che siano arrivati dall'Atlantico orientale.*

Parole chiave: Osteichthyes, Labridae, *Labrus mixtus*, acque della Tunisia, Mediterraneo centrale

INRODUCTION

The cuckoo wrasse *Labrus mixtus* Linnaeus 1758 is widely and continuously distributed throughout the eastern Atlantic from Norway to the Gibraltar Strait (Quignard & Pras, 1986; Quéro *et al.*, 2003). Southwards, the species is reported off Morocco (Lloris & Rucabado, 1998), Senegal and from the Azores and Madeira Islands (Gomon & Forsyth, 1990). *L. mixtus* is known in the Mediterranean Sea, especially in the western basin (Quignard & Pras, 1986) and the Adriatic Sea (Šoljan, 1975; Lipej & Dulčić, 2010). The species is not recorded in the Black Sea (Quignard & Tomasini, 2000) and is considered to be rather rare in the eastern Mediterranean basin (Bilecenoglu *et al.*, 2002; Golani, 2005).

The first recorded sighting in Tunisian waters of *L. mixtus* was by Gruvel (1926) in the southern Gulf of Gabès. Later it was documented further north in the Gulf of Tunis by Lubet & Azzouz (1969) but no specimens were available to date for confirmation. Observations conducted over several decades throughout the Tunisian coast did not permit the recording of new specimens of *L. mixtus*; consequently, Bradaï (2000) and Bradaï *et al.* (2004) referred to the species as a rarity in the area. Since 2006, investigations carried out from northern Tunisian waters, including the Lagoon of Bizerte, presented the opportunity to find previously unknown species and/or confirm the occurrence of rare fish species (El Kamel *et al.*, 2009; Mnasri *et al.*, 2009, 2010; Azzouz *et al.*, 2010, 2011; Mansour *et al.*, 2011; Rafrafi-Nouira *et al.*, 2011).

MATERIAL AND METHODS

On 07 February 2011, two specimens of *L. mixtus*, a male and a female, were caught off the coast of Ras Jebel, a city located in northern Tunisia (37° 15′ 19.91″ N and 10° 06′ 16.18″ E), 45 km north to Tunis. The study used 30 mm mesh gill nets set at between 10 and 12 m of depth on rocky bottoms partially covered by marine vegetation. Specimens of other labrid and sparid species were also recorded at this time (Fig. 1).

Male and female specimens were identified using field guides such as Quignard (1966), Wheeler (1969) and Quignard & Pras (1986), photographed, and then measured to the nearest millimetre (Fig. 2). Total body mass and removed organs, such as liver and gonads, as well as stomach contents were weighed to the nearest decigram. Stomach contents showing prey items were identified to the lowest taxon possible. Gonads and stomach contents were examined by naked eyes and under binocular microscope.

RESULTS AND DISCUSSION

Both male and female specimens were identified as follows: body oval and elongate. Mouth protrusible, rather large with thick lips reaching almost to the eye level and canine-like teeth, sharp, pointed snout. Scales moderate in size, rather smaller than pupil diameter. Dorsal fin uniform in height, its soft part longer than high. Anal fin uniform in height. Colour remarkably different for males and females. Male with black head, back featuring blue and green lines; sides, belly, dorsal and other fins orange. Female with orange-pink body, rather paler on the belly; three dark spots on the back, the first at the junction of the spines and soft rays of dorsal fin, the second at the end of fin, the third on upper margin of caudal peduncle. Whitish spots also visible between the dark spots.

Both specimens are preserved in 10 % buffered formaline and deposited in the Ichthyological Collection of the Faculté des Sciences de Bizerte, with catalogue numbers FSB-Lab-mix-01 and FSB-Lab-mix-02 for the male and female specimens, respectively.

The morphological description, colour, morphometric measurements with proportion of standard length (% SL) and meristic counts (see Table 1) are in agreement with Quignard (1966), Wheeler (1969) and Quignard & Pras (1986). The male and the female measured 336 mm and 301 mm in total length, respectively, and weighed 500.9 g and 379.4 g, respectively. They were large specimens, probably adults, following Quignard & Pras (1986) who reported that from the Mediterra-

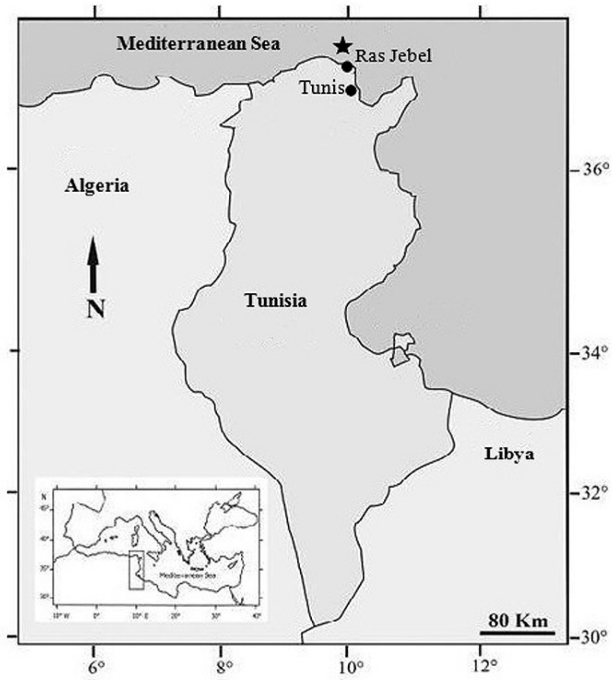

Fig. 1: Map of the Mediterranean Sea showing Tunisia and map of the coast of Tunisia with black star pointing out the capture site of *Labrus mixtus*.
Sl. 1: Zemljevid Sredozemskega morja in Tunizije ter zemljevid tunizijske obale. S črno zvezdico je označena lokacija ulova vrste *Labrus mixtus*.

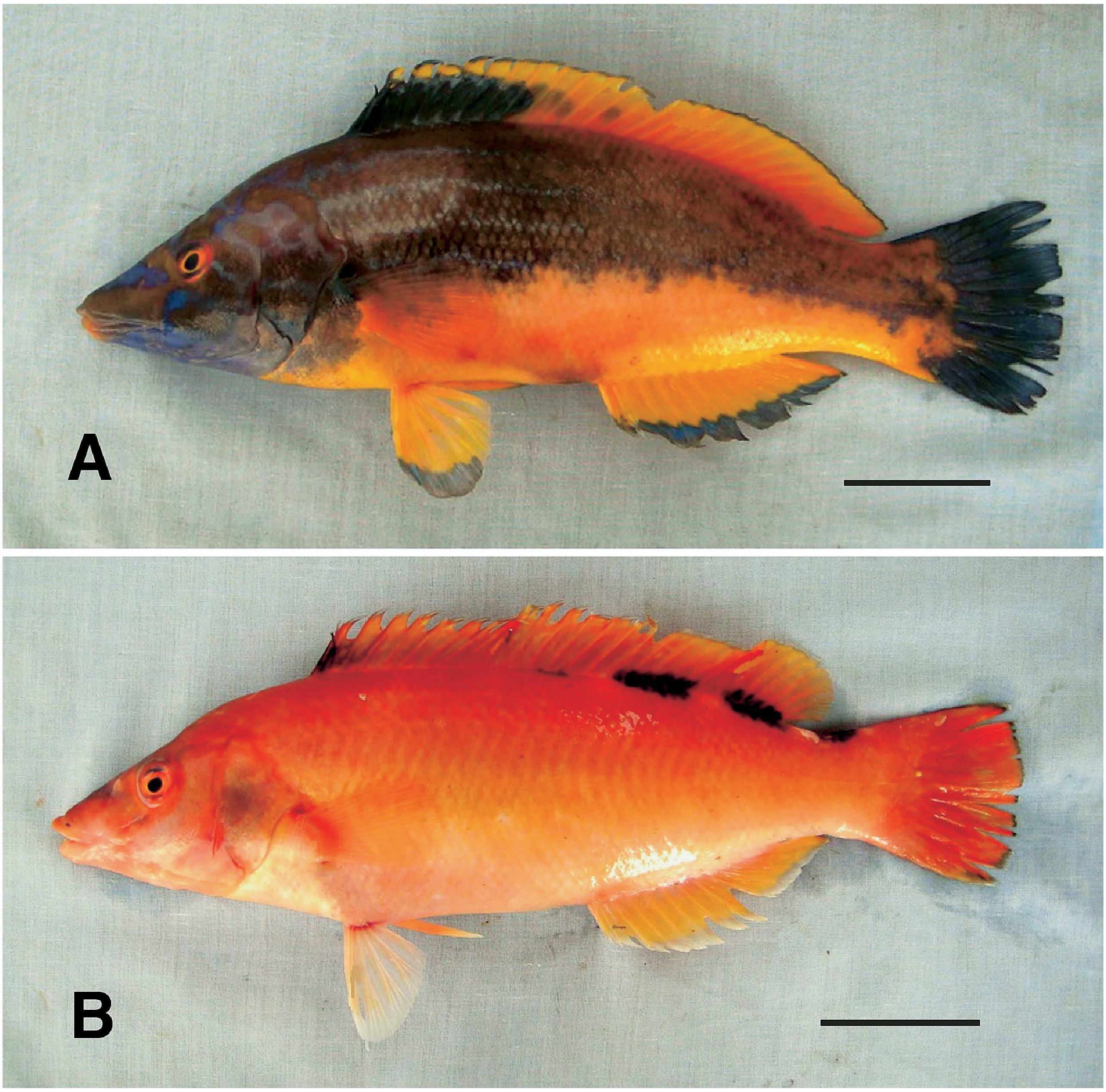

Fig. 2: *Labrus mixtus*. **(A) Male specimen, (B) female specimen. For both specimens, scale bar = 50 mm.**
Sl. 2: Vrsta *Labrus mixtus*. **(A) Moški primerek, (B) ženski primerek. Pri obeh primerkih je merilo 50 mm.**

nean, 7 year-old males and females measured 260 mm and 240 mm total length, respectively, while 17 year-old males measured 325 mm total length. The testes were partially damaged and it was impossible to make a reliable statement about the condition of this male. The ovary was externally granulous and contained pre-vitellogenic oocytes. This female was probably a pre-spawning specimen. The gut of both specimens contained remains of undeterminable crustaceans, probably crabs, confirming previous observations reported by Wheeler (1969).

Both records of *L. mixtus* reported in this paper confirm the occurrence of the species in the northern Tunisian waters. Conversely, the occurrence of the species further to the south is doubtful according to Bradaï (2000), who has not observed any specimen, despite careful and thorough investigations conducted in the Gulf of Gabès over the course of several decades, so Gruvel's findings (Gruvel, 1926) remain questionable.

L. mixtus is attested in the colder temperate waters of seas from northern Europe; however, its occurrence southward in warmer waters, continuously from off the

coast of Morocco to as far south as Senegal, suggest that it is probably an eurytherm fish species, able to support temperature changes in the wild. This goes some way towards explaining its occurrence in Tunisian waters. However, the question remains: are these recent captures of *L. mixtus* derived from a local population, previously established in the area, or are they the consequence of migrations from the eastern Atlantic through the Gibraltar Strait? It appears difficult to state, both hypothesis remaining valid.

Tab. 1: Morphometric measurements in mm and as % standard length (% SL), meristic counts and weights recorded in male and female cuckoo wrasse *Labrus mixtus* **caught in the Tunisian waters.**
Tab. 1: Morfometrične meritve v mm in v % glede na standardno dolžino (% SL), meristična štetja in teža, izmerjena pri moškem in ženskem primerku vrste *Labrus mixtus,* **ujete v tunizijskih vodah.**

Reference	**FSB-Lab-mix-01**		**FSB-Lab-mix-02**	
Sex	**Male**		**Female**	
Morphometric measurements	**mm**	**% SL**	**mm**	**% SL**
Total length	336	112.7	301	114.0
Standard length	298	100.0	264	100.0
Pre-dorsal fin length	101	33.8	95	35.9
Pre-pectoral fin length	96	32.2	86	32.5
Pre-anal fin length	174	58.3	160	60.6
ocular diameter	15	5.0	13	4.9
Dorsal fin length	151	50.6	139	52.6
Pectoral fin length	18	6.0	14	5.3
Anal fin length	60	20.1	53	20.0
Pelvin fin length	11	3.6	6	2.7
Caudal fin length	43	14.4	33	12.5
Body height	47	15.7	41	15.5
Pre-orbitary length	37	12.4	35	13.2
Post-orbitary length	44	14.7	38	14.3
Head length	97	32.5	86	32.5
Inter-orbitary length	23	7.7	19	7.1
Meristic counts				
Dorsal fin rays	XVII+14		XVII+14	
Pectoral fin rays	16		16	
Anal fin rays	III+12		III+12	
Caudal fin rays	15		16	
Pelvic fin rays	I+5		I+5	
Gill rakers	17		17	
Lip folds	7		7	
Vertebrae	39		39	
Scales along lateral line	48		48	
Scales behind eye	8		8	
Scales on cheeks	8		8	
Weight (in dg)				
Total body	500.9		379.4	
Eviscerated body	469.8		343.1	
Liver	4.4		6.4	
Gonad	-		9.5	
Stomach contents	17.5		12.5	

POTRJENO POJAVLJANJE VRSTE *LABRUS MIXTUS* (OSTEICHTHYES: LABRIDAE) V TUNIZIJSKIH VODAH (OSREDNJE SREDOZEMLJE)

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POVZETEK

Avtorja članka poročata o ulovu dveh velikih, odraslih primerkov vrste Labrus mixtus, *in sicer moškega in ženskega spola, v severnih tunizijskih vodah. Ulov potrjuje prisotnost vrste na območju, kjer je sicer zelo redko prisotna. Izvor obeh primerkov ostaja neznan: vrsta je bodisi avtohtona bodisi neavtohtona, pri čemer ne moremo izključiti izvora iz vzhodnega Atlantika.*

Ključne besede: Osteichthyes, Labridae, vrsta *Labrus mixtus*, tunizijske vode, osrednje Sredozemlje

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VERTICAL DISTRIBUTION OF SOFT BOTTOM MACROZOOBENTHOS IN THE GULF OF TRIESTE (NORTHERN ADRIATIC SEA)

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ABSTRACT

The macrozoobenthos is commonly considered to be the main agent of bioturbation in shallow water, and responsible for the enhancement of the interchange of both dissolved and gaseous species between the pore waters and the upper water column. As reported by several authors, this basic phenomenon is usually investigated by describing the vertical distribution of macrobenthic organisms. For this purpose, a site located in the central part of the Gulf of Trieste (depth = 21 m) was selected and, during 1999/2000, 9 core samples were collected in triplicate to a maximum depth of 20 cm. The vertical distribution of the macrozoobenthic communities was described by applying the bioturbation activity index (BA). The vertical distribution of macrofauna showed a clear decrease in both number of taxa and abundance when moving downcore. The BA suggested that surficial, detritus-feeding polychaetes have a pivotal role in the bioturbation of muddy sediments, whereas suspension-feeding molluscs are also important if the only top layer is considered. Taking into account the overall results, it can be stated that the BA index application based on the core sampling technique, could be a useful tool in describing bioturbation in the northern Adriatic soft bottom sediments.

Key words: macrozoobenthos, vertical zonation, bioturbation index, feeding guilds, Gulf of Trieste, Adriatic Sea

DISTRIBUZIONE VERTICALE DEL MACROZOOBENTHOS DI FONDO MOBILE NEL GOLFO DI TRIESTE (ALTO ADRIATICO)

SINTESI

Il macrozoobenthos viene comunemente considerato il maggiore agente dei fenomeni di bioturbazione nelle acque costiere, il quale facilita gli scambi della sostanza disciolta e gassosa tra le acque interstiziali e la sovrastante colonna d'acqua. Per tale motivo, questi fenomeni di scambio possono essere indagati in via preliminare attraverso la descrizione della distribuzione degli organismi bentonici lungo il profilo sedimentario. A tale scopo è stato selezionato un sito di studio nella parte centrale del Golfo di Trieste. Durante il periodo 1999-2000 sono stati condotti 9 campionamenti, considerando un adeguato numero di repliche (3 repliche per campionamento), alla massima profondità di 20 cm nel sedimento. In questi campioni è stata descritta la distribuzione verticale del macrozoobenthos e inoltre è stato applicato un indice di bioturbazione (BA). La distribuzione verticale della macrofauna indica un chiaro decremento degli organismi dagli strati superficiali verso quelli più profondi, sia in termini di taxa presenti che di abbondanza degli individui. L'applicazione dell'indice di bioturbazione ha fatto rilevare che i policheti detritivori di superficie possono assumere un ruolo principale nella bioturbazione dei sedimenti fangosi dell'area centrale del Golfo di Trieste, cui fanno seguito i molluschi sospensivori nei soli strati superficiali. Pertanto l'applicazione di tale indice, anche accoppiato alla tecnica di campionamenti con il carotaggio, potrebbe risultare un utile strumento per descrivere la bioturbazione nei fondi mobili dell'Alto Adriatico.

Parole chiave: macrozoobenthos, zonazione verticale, indice di bioturbazione, categorie trofiche, Golfo di Trieste, Mare Adriatico

INTRODUCTION

One of the main factors affecting the species composition within a macrobenthic community is the nature and quality of the substratum (Gray, 1974). It is well established that when fine sediments prevail, the presence of an interstitial fauna is greatly inhibited due to the high packing of the substratum, poor water circulation and, as a consequence, low oxygen content. Conversely, medium and fine sands are characterised by the presence of an abundant fauna, which shows several adaptive strategies (Gray, 1981). The fauna plays a pivotal role in physical phenomena such as bioturbation through building tubes, constructing burrows, feeding pits, transports sediments, thus enhancing the exchange of dissolved (nutrients, trace element etc.) and gas phases between the sea bed and water column. In addition, some abiotic factors (*e.g.*, sedimentation rates, quality and quantity of organic matter, OM) can influence the trophic structure, abundance and biomass of the macrobenthic community and the pattern of colonisation through the sediment layers (Pearson & Rosenberg, 1978; Gray & Mirza, 1979; Warwick, 1986; Marsh & Tenore, 1990; Dauer & Alden, 1995; Flach & Heip, 1996; Dauer, 1997; Dauwe *et al*., 1998). In particular, the importance of OM becomes evident when it increases and generates more biomass and density of the benthic organisms; under these conditions, dystrophic events – such as hypoxia or anoxia and the strong and prolonged pycnocline of the water column – cause massive reductions and/or elimination of the benthic fauna (Simonini *et al*., 2004) and important changes in both the physical and chemical characteristics of the top sediment layers (Heip *et al*., 1995).

To date, knowledge about bioturbation is mainly related to the consequences and the influence on abiotic factors such as physical-chemical parameters, whereas the role of vertical distribution of macrozoobenthic organisms in the sediment has scarcely been investigated. This work provides a first analysis of the vertical zonation of the macrozoobenthos in the muddy bottom sediments of the Gulf of Trieste, followed by the application of the bioturbation activity index (BA).

MATERIAL AND METHODS

Study area

The Gulf of Trieste is located at the northwestern part of the Adriatic Sea, covers an area of about 600 km^2 and reaches a maximum depth of about 25 m in its central part. As reported in Ogorelec *et al*. (1991), 10 % of the total area has a depth < 10 m. The water circulation system, which is affected by the action of both winds (ENE) and tides (average and spring ranges of 0.5 and 1 m, respectively), is anticlockwise and acts on deep-water layers, which flow permanently at 2–3 cm s^{-1}. Wind-driven superficial currents differentiate the uppermost water mass, down to a depth of about 5 m, flowing anticlockwise with easterly winds and clockwise with westerly winds (Stravisi, 1983). The average salinity ranges between 33 to 38 at the surface and 36 to 38.5 at the bottom (Stravisi, 1983; Cardin & Celio, 1997). The Isonzo River represents the primary freshwater input, with an average annual flow rate estimated at the river mouth (period 1998–2005) of 91.2 m^3 s^{-1} (1.1–665.9 m^3 s^{-1}; Comici & Bussani, 2007). The riverine discharge shows significant seasonal variations with two typical flood events: a relatively long spring maximum (March–May) and a shorter, but more intense, autumn maximum (September–November), when the rate of flow can exceed 2,500 m^3 s^{-1} (RAFVG, 1986). The annual water temperatures range from 8 to 24 °C and from 8 to 20 °C at the surface and bottom, respectively. Tidal amplitude is about 1.5 m, which is the highest of the Mediterranean Sea.

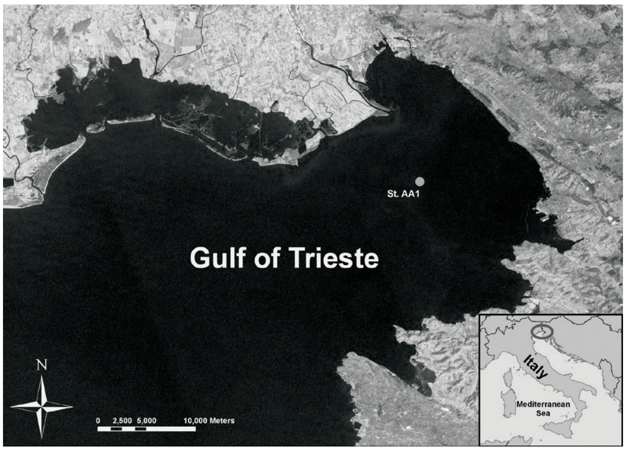

Fig. 1: Gulf of Trieste and sampling station AA1.
Sl. 1: Tržaški zaliv in vzorčevalna postaja AA1.

The sedimentation rate is mainly controlled by river input rather than by marine currents (Brambati & Catani, 1988). Measurements based on ^{210}Pb determinations estimated it to be 1.84–2.1 mm a^{-1} in the mid-Gulf (station AA1, Ogorelec *et al*., 1991; Covelli *et al*., 2001), and up to 2.5 mm a^{-1} adjacent to the river mouth (Ogorelec *et al*., 1991). The soft bottom composition is not homogeneous and varies from sands with patches of beach rocks to mud, predominantly detrital (Brambati *et al*., 1983). The widespread benthic biocoenoses of the Gulf belong to the DC (Détritique Cotier), DE (Détritique Envasé) and VTC (Vases Terrigenes Cotieres) biocoenoses (Orel & Mennea, 1969; Solis-Weiss *et al*., 2004).

Three main natural factors influence the composition, evolution and persistence of marine life in the Gulf of Trieste: strong winds (mainly Bora), stratification of the water column, leading to occasional hypoxia and/or anoxia events, as well as occasional mucilage production (Solis-Weiss *et al*., 2001).

This study was carried out at one station (AA1) located in the middle of the Gulf of Trieste (45° 39′ 48″ N, 13° 35′ 42″ E) at a depth of about 21 m (Fig. 1). The main solid phase and chemistry characteristics of AA1 are reported in Emili *et al*. (2011). The sediment texture consists of clayey silt (< 63 μm, from 87 to 98 %; Hines *et al*., 2000), whereas C_{tot} and C_{org} account for about 5.1 and 1.17 %, respectively. Previous studies reported the occurrence of hypoxia and anoxia events, such as mucilage aggregate deposition at the bottom (Aleffi *et al*., 1992).

Sampling

Benthic samples were collected in 1999 (February, June and August) and 2000 (January, June, July, August, October and December) using a KC Haps bottom corer (KC-Denmark, Silkeborg, Denmark) with a polycarbonate sample tube (i.d. = 13.3 cm; sample area = 127 cm^2). In order to assess the vertical distribution, three replicate samples were randomly collected. After sediment collection, each core was sectioned in slices (0-1, 1-3, 3-5, 5-10 and 10-20 cm). The sediment was sieved through a 0.5 mm mesh and subsequently stored in 4 % formaldehyde following standard methods (Holme & McIntyre, 1984). Faunal samples were sorted and identified at the lowest possible taxonomical level.

Analyses

In order to analyse the structure of the communities, several univariate techniques are commonly employed. Among these the abundance, the number of taxa and the diversity index were previously used (Shannon-Wiener diversity index, H′, on $\log_2$ basis; Shannon & Weaver, 1949). The feeding guild analysis was based on Fauchald & Jumars' (1979), Bachelet's (1981) and Macdonald's *et al*. (2010) definitions.

Bioturbation activity (BA) was estimated by means of the scoring system outlined in Swift (1993) and Grehan *et al*. (1994). Briefly, the scores were assigned to all taxa on the basis of individual feeding mode (0-4), mobility (0-3) and burrowing capability (0-4); the maximum value of 11 represents the species characterised by the greatest potential capacity to cause sediment bioturbation.

Tab. 1: Minimum, maximum and mean value of abundance, number of taxa and H′ of a core.
Tab. 1: Minimalna, maksimalna in povprečna vrednost števila osebkov, števila taksonov in H′ jedra vrtine.

	Abundance	No. Taxa	H′
Min	52	15	3.26
Max	270	50	4.65
Mean	163	32	3.98

RESULTS

A total of 1,471 organisms belonging to 90 taxa were identified in the 27 sampled cores. Table 1 displays minimum, maximum and mean values of abundance, number of taxa and H′ in the cores. The most abundant taxa were polychaetes (57.8 %) followed by molluscs (24.4 %) and crustaceans (13.2 %), thus accounting together for the 95.4 % of the specimens. Other taxa such as

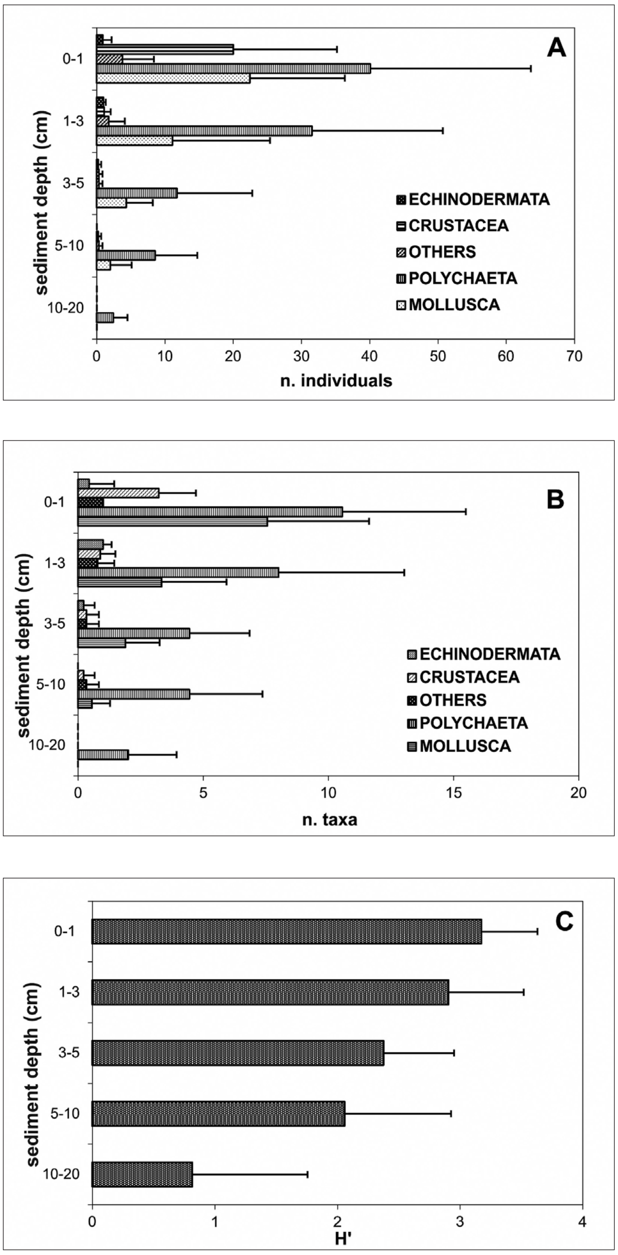

Fig. 2: (A) Average value of abundance, (B) number of main taxa and (C) H′ for each layer of the core.
Sl. 2: (A) Povprečno število osebkov, (B) število najpomembnejših taksonov in (C) H′ za vsak sloj jedra vrtine.

echinoderms, sipunculids, ascidians, anthozoans and nemertines were poorly represented. The polychaetes were also the dominant taxon in term of number of species (44 sp.), followed by molluscs (28 sp.) and crustaceans (11 sp.); together these constituted 91 % of the species.

The vertical distribution of macrofauna showed a clear decrease in both taxa and abundance moving downcore. At the 10-20 cm layer, only polychaetes were found, whereas echinoderms disappeared below 5 cm. H' dropped at the 10-20 cm layer (Fig. 2).

Feeding guilds were mostly represented by suspension and surface deposit feeders, both in terms of abundance and taxa, followed by carnivores, sub-surface deposit feeders and grazers. Suspension feeders were the dominant guild at the top. Surface deposit feeders showed similar abundance in 0-1 and 1-3 cm layers, but dropped in 3-5 cm. Carnivores and sub-surface deposit feeders showed a constant decrease down core, whereas grazers were scarcely represented and disappeared below 10 cm (Fig. 3).

As reported in Table 2, twelve species represented about 50 % of the total abundance. Among these, some suspension feeders such as the bivalves *Corbula gibba* and *Venerupis aurea* and the amphipods *Ampelisca* spp. were mostly abundant at the topmost layers (0-3 cm). *C. gibba* and *Ampelisca spp.* completely disappeared after 3 cm while *V. aurea* was found until 5 cm (Fig. 4). The bivalve *Mysella bidentata* and several surface deposit feeders species such as the polychaetes *Laonice cirrata*, *Prionospio cirrifera* and the sipunculid *Aspidosiphon muelleri muelleri* gradually decreased with depth, until 10 cm. *M. bidentata* and *P. cirrifera* peaked the abundance in 1-3 cm. Taking into consideration the carnivores, the polychaetes *Lumbrineris gracilis* and *Eunice vittata* gradually decreased from the top till 5 and 20 cm respectively, whereas the *Lumbrineris latreilli* distribution did not show any significant trend along the se-

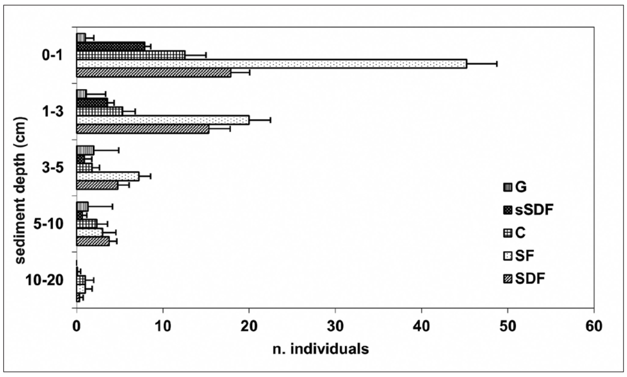

Fig. 3: Average abundance of feeding guilds for each layer of the core.
Sl. 3: Povprečno število osebkov prehranskega ceha za vsak sloj jedra vrtine.

Tab. 2: Total abundance (A), frequency (F), percentage (%) and cumulative percentage (% cum) of the twelve most abundant species. Feeding guilds (F. guilds): SDF = surface deposit feeders, SF = suspension feeders, G = grazers, sSDF = subsurface deposit feeders, C = carnivores. Taxa: Cru = crustaceans, Mol = molluscs, Pol = polychaetes.
Tab. 2: Skupno število osebkov (A), pogostost (F), odstotki (%) in kumulativni odstotki (% cum) dvanajstih vrst z največjim številom osebkov. Prehranski cehi (F. guilds): SDF = površinski detritivori, SF = suspenziofagi, G = strgalci, sSDF = podpovršinski detritivori, C = karnivori. Taksoni: Cru = raki, Mol = mehkužci, Pol = mnogoščetinci.

F. guilds	Taxa	Species	A	F	%	% cum
SDF	Pol	*Prionospio cirrifera*	162	7	11.0	11.0
SF	Cru	*Ampelisca* spp.	135	9	9.2	20.2
SF (SDF)	Mol	*Mysella bidentata*	135	7	9.2	29.4
SF	Mol	*Corbula gibba*	57	9	3.9	33.2
SDF	others	*Aspidosiphon muelleri*	51	7	3.5	36.7
G	Mol	*Hyala vitrea*	44	7	3.0	39.7
SF	Mol	*Venerupis aurea*	36	7	2.4	42.2
sSDF	Pol	*Maldane glebifex*	32	6	2.2	44.3
C	Pol	*Lumbrineris gracilis*	27	4	1.8	46.2
SDF	Pol	*Laonice cirrata*	24	3	1.6	47.8
C	Pol	*Lumbrineris latreilli*	23	5	1.6	49.4
C	Pol	*Eunice vittata*	22	5	1.5	50.9

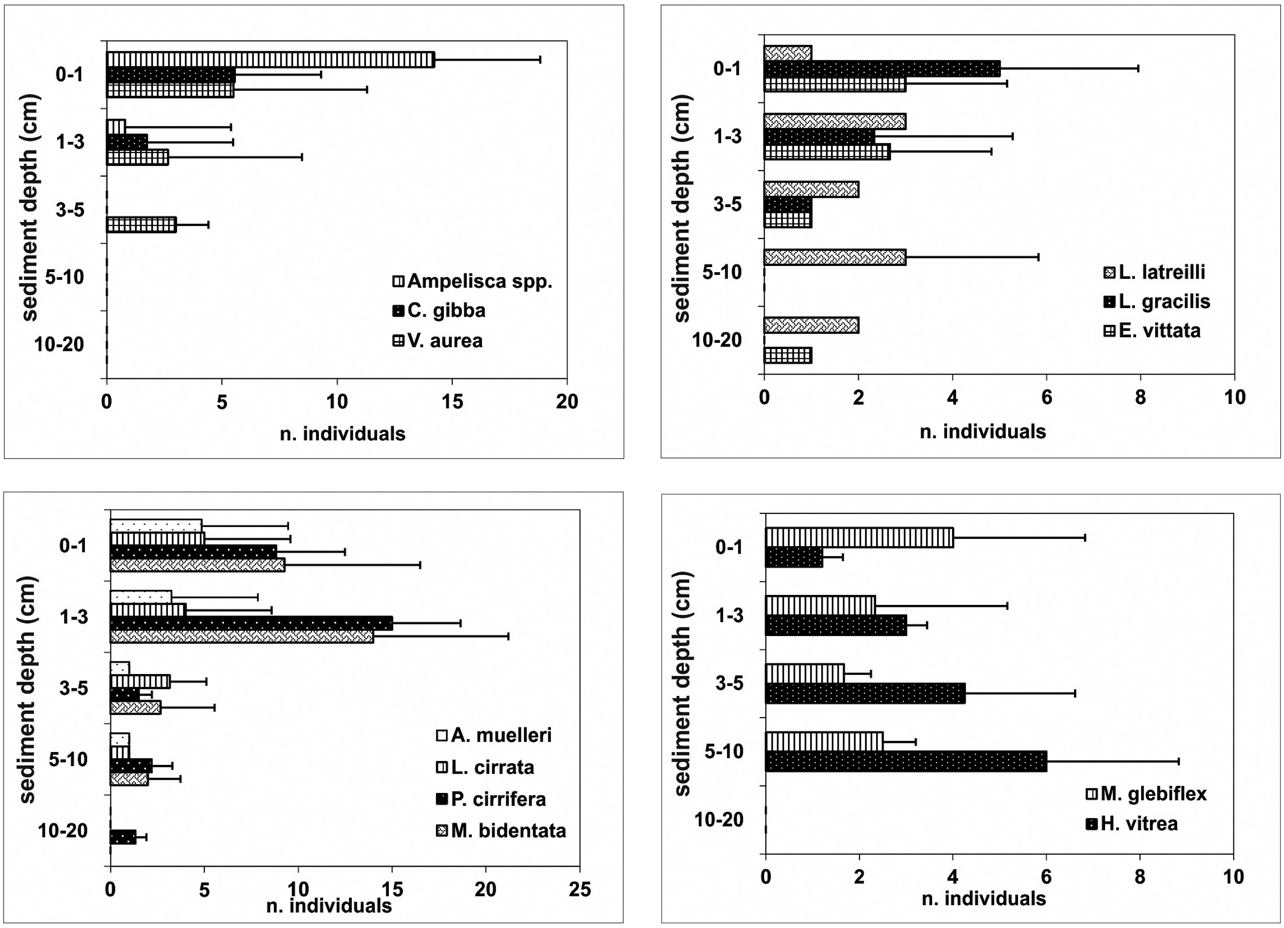

Fig. 4: Average abundance of the dominant species for each layer of the core.
Sl. 4: Povprečno število osebkov prevladujoče vrste za vsak sloj jedra vrtine.

dimentary sequence. The polychaete *Maldane glebifex* mostly represented sub-surface deposit feeders within the upper 10 cm without any clear decreasing gradient. Conversely, the grazer gastropod *Hyala vitrea* showed an increase in abundance from the top until 10 cm, below where it disappeared.

The BA score assigned to each taxon is shown in Table 3. BA estimated for feeding guilds showed a mean of 8 for SSDF, 5 for SDF and 2 for remaining guilds; with regard to main taxa the average was 4 for polychaetes and crustaceans, 3 for echinoderms and others and 2 for molluscs.

The trend of BA downcore showed a significant average decrease for every feeding guild. Moreover, it seems to be clear that SDF represents the most important class, which contributes to the index value in the whole of the layers investigated. Finally, BA calculated on main taxa indicates that polychaets are the main responsible for the bioturbation phenomena, whereas the contribution of molluscs seems to be important only in the upper layer (Fig. 5).

DISCUSSION

The vertical zonation of benthic organisms within the sediment has long attracted the attention of marine biologists. Since macrobenthic and meiobenthic bioturbation is an important phenomenon in surficial marine sediments (Cullen, 1973), even geologists and geochemists have emphasised the necessity for information on patterns of vertical distribution in the marine benthos (Huys *et al*., 1986).

Several authors have described in the past the different macrozoobenthic communities in the Gulf of Trieste (*e.g*., Orel & Mennea, 1969; Fedra *et al*., 1976; Fedra, 1978; Orel et al., 1987), often in connection with anoxia conditions (*e.g*., Stachowitsch, 1984; Aleffi *et al*., 1992; Orel *et al*., 1993; Stachowitsch & Fuchs, 1995). Recently, the status and distribution of macrobenthic communities was discussed through the application of GIS techniques (Solis-Weiss *et al*., 2001) and a faunistic, biocoenotic and ecological survey on soft bottom macrozoobenthos was conducted in the southern part of the Gulf (Mavrič *et al*., 2010). Apart from some studies concerning the

vertical distribution of meiobenthos in the southern area of the Gulf (Vrišer, 1983-1984), there are very few data regarding the vertical zonation of soft bottom macrozoobenthos.

The development of the macrobenthic community at station AA1 was followed from 1990 to 2001. This area was affected by anoxia in September 1990, when oxygen (O_2) concentrations at the bottom dropped to 0.37 cm^3 l^{-1}. In 1991 a mucilage event occurred during the summer and the lowest value of O_2 was recorded in October (1.28 cm^3 l^{-1}), whereas in 1992 the minimum value was measured in August (3.46 cm^3 l^{-1}). During the period 1999-2001, no O_2 concentration at the bottom below 2.00 cm^3 l^{-1} was recorded, except in October 2001, when 1.69 cm^3 l^{-1} was found. In addition, mucilage aggregates occurred in June 2000 (Bettoso *et al*., 2003). A clear difference was revealed between the benthic community of the investigated periods 1990-1993 and 1999-2001 at the same site of the present study. Average H' and J values were 1.89, 0.56 and 2.9, 0.79 in the former and latter period, respectively. A remarkable result during the period 1990-1993 (characterised by frequent hypoxia-anoxia events) was the huge abundance of the suspension feeder bivalve *Corbula gibba*, which is a well-known indicator of environmental instability condition (Aleffi & Bettoso, 2000). From 1999-2001 and in the present study, the environmental conditions were more stable, without any noticeable chemical-physical stress. Accordingly, a notable decrease of the *C. gibba* dominance was detected. Similar trends were revealed for the polychaetes *Maldane glebifex* and *Eunice vittata*, which were found to be dominant together with *C. gibba* in the early 1990s (Aleffi *et al*., 1996). In contrast, several species, never recorded or very scarce, were abundant in 1999-2001. Among these, the gastropod *Aporrhais pespelecani*, the sipunculid *Aspidosiphon muelleri muelleri* and the polychaetes *Sternaspis scutata* and *Sthenolepis yhleni* are the most important. Moreover, the constant presence of *Atrina pectinata* was also remarkable because this large bivalve seems to be very sensitive to low oxygen levels (Bettoso *et al*., 2003). During 1999-2001 the presence of *Ampelisca* spp. was also remarkable. Moodley *et al*. (1998) observed that *C. gibba* abundance may be negatively affected by the presence of large population of *Ampelisca*. The authors consider the two species as suspension feeders that compete for food supply. Moreover, they suggested that dense aggregations of *Ampelisca*, which build tubes in the more superficial layers of sediment, could both occupy space and influence the structure and density of the community down core (Dauvin, 1988; Dauvin & Bellan-Santini, 1990; Massamba N'Siala *et al*., 2008).

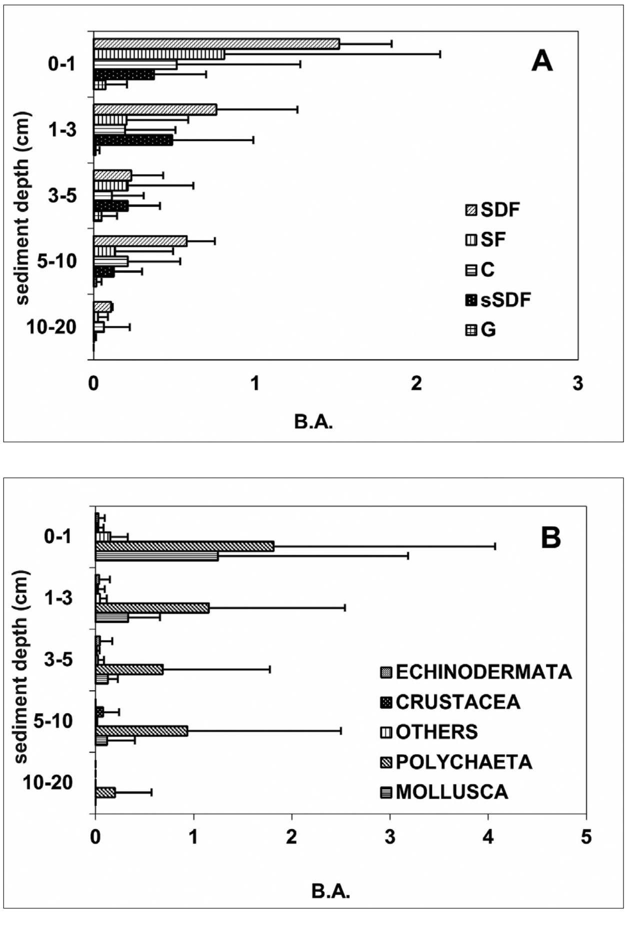

Fig. 5: (A) Average BA for feeding guilds and (B) main taxa in each layer of the core.
Sl. 5: (A) Povprečen indeks BA za vsak prehranski ceh in (B) najpomembnejši taksoni za vsak sloj jedra vrtine.

Despite a low number of species detected with this sampling method, the percentage abundances of the most abundant taxa in the cores were comparable to those recorded by grab sampling (Aleffi *et al*., 1996; Bettoso *et al*., 2003). Unfortunately, no recent data for this sampling station were available, although no stress condition due to oxygen depletion was recorded in the last decade.

The infaunal macrozoobenthos distribution indicates that the colonisation of the sediment occurs at the maximum depth of 20 cm, according to Moodley *et al*. (1998) for the northwestern Adriatic Sea; however, as already observed by Simonini *et al*. (2004) in the area close to the Adige and Po River mouths, it essentially involves the first 5 cm, whereas a sharp decline of macrofauna occurred below 10 cm.

The vertical distribution of feeding guilds followed a well-defined pattern in which the suspension and surface deposit feeders are mostly found in the surface layers, whereas sub-surface deposit feeders and carnivores-omnivores followed below. Among suspension feeders *Ampelisca* spp., *C. gibba* and *Venerupis aurea* were not encountered in deeper layers as also observed by Moodley *et al*. (1998). In contrast, the bivalve *Mysella bidentata* was not confined to a specific layer. These

Tab. 3: Bioturbation activity (BA) assigned to taxa as outlined in Swift (1993) and Grehan* et al. *(1994): M = mobility, F = feeding mode, B = burrowing capability. For explanations (F. guilds, Taxa except Ech = echinoderms) see Table 2.

Tab. 3: Bioturbacija (BA), kot so jo posamičnim taksonom pripisali Swift (1993) ter Grehan* et al. *(1994): M = mobilnost, F = način prehranjevanja, B = zmožnost kopanja rovov. Za razlago (Prehranski cehi, Taksoni razen Ech = iglokožci) glej Tabelo 2.

M	F	B	BA	F. guilds	Taxa	Species
2	1	1	4	C	others	Nemertea indet.
1	0	1	2		Mol	*Nassarius reticulatus*
1	0	1	2		Mol	*Cylichnina umbilicata*
0	0	0	0		Mol	*Akera bullata*
1	0	0	1		Mol	*Scaphander lignarius*
1	4	1	6		Mol	*Antalis inaequicostata*
3	0	2	5		Pol	*Glycera* sp.
0	0	0	0		Pol	*Ophiodromus flexuosus*
0	1	2	3		Pol	*Sigambra tentaculata*
0	0	2	2		Pol	Syllidae indet.
2	0	0	2		Pol	*Nereis lamellosa*
2	0	0	2		Pol	*Nereis rava*
2	0	0	2		Pol	*Nereis* sp.
2	0	2	4		Pol	*Micronephtys* sp.
0	0	0	0		Pol	*Sthenolepis yhleni*
0	0	0	0		Pol	*Nothria conchylega*
0	0	0	0		Pol	*Eunice vittata*
2	0	2	4		Pol	*Lumbrineris gracilis*
2	0	2	4		Pol	*Lumbrineris latreilli*
2	0	2	4		Pol	*Lumbrineris tetraura*
1	2	0	3		Cru	Gammaridae indet.
0	0	0	0		Cru	*Athanas nitescens*
0	0	0	0		Cru	*Eualus cranchii*
0	0	0	0		Cru	*Processa macrophthalma*
1	1	1	3	G	Mol	*Hyala vitrea*
1	0	0	1		Mol	*Calyptraea chinensis*
1	0	0	1		Mol	*Capulus ungaricus*
1	2	0	3	SDF	Mol	*Euspira pulchella*
0	3	1	4		Mol	*Nucula nucleus*
0	3	1	4		Mol	*Nuculana pella*
0	2	1	3		Mol	*Thyasira flexuosa*
1	0	0	1		Mol	*Mysella bidentata*
0	2	1	3		Mol	*Tellina distorta*
0	3	1	4		Mol	*Abra alba*
0	3	1	4		Mol	*Abra prismatica*
1	0	1	2		Mol	*Thracia pubescens*
2	3	0	5		Pol	*Laonice cirrata*
2	3	0	5		Pol	*Polydora flava*
2	3	0	5		Pol	*Prionospio cirrifera*
2	3	0	5		Pol	*Prionospio malmgreni*
2	3	2	7		Pol	*Magelona* sp.
2	3	0	5		Pol	*Poecilochaetus serpens*
3	3	2	8		Pol	*Aricidea* sp.
3	3	2	8		Pol	*Levinsenia gracilis*
3	3	2	8		Pol	*Paradoneis lyra*
3	3	2	8		Pol	*Paraonidae indet.*
1	2	1	4		Pol	*Chaetozone setosa*
1	2	1	4		Pol	*Tharyx killariensis*
1	2	1	4		Pol	Cirratulidae indet.
2	1	2	5		Pol	Opheliidae indet.
0	2	1	3		Pol	*Ampharete acutifrons*
0	2	2	4		Pol	*Melinna palmata*
0	2	0	2		Pol	*Amphitrite variabilis*
0	2	0	2		Pol	Terebellidae indet.
2	1	2	5		Pol	Oligochaeta indet.
0	2	0	2		others	*Aspidosiphon muelleri muelleri*
2	2	2	6		others	*Sipunculus nudus*
3	4	4	11		Cru	Callianassidae indet.
2	2	2	6		Ech	*Amphiura chiajei*
0	2	0	2		Ech	*Amphipholis squamata*
0	0	0	0	SF	others	*Cerianthus membranaceus*
0	0	0	0		Mol	*Anomia ephippium*
1	2	1	4		Mol	*Loripes lacteus*
1	2	1	4		Mol	*Myrtea spinifera*
1	0	0	1		Mol	*Kellia suborbicularis*
0	0	1	1		Mol	*Acanthocardia paucicostata*
0	0	1	1		Mol	*Dosinia lupinus*
0	0	1	1		Mol	*Pitar rudis*
0	0	1	1		Mol	*Venerupis aurea*
1	0	0	1		Mol	*Corbula gibba*
2	3	0	5		Pol	*Polydora* sp.
2	3	0	5		Pol	Spionidae indet.
0	0	0	0		Pol	Sabellidae indet.
0	2	0	2		Pol	*Spiochaetopterus costarum*
1	2	0	3		Cru	Cumacea indet.
0	0	0	0		Cru	*Ampelisca* spp.
3	4	4	11		Cru	*Upogebia tipica*
0	0	1	1		Ech	*Leptopentacta elongata*
2	3	2	7	sSDF	Pol	Capitellidae indet.
2	3	2	7		Pol	*Euclymene* sp.
2	4	2	8		Pol	*Maldane glebifex*
2	4	2	8		Pol	Maldanidae indet.
2	1	2	5		Pol	*Sternaspis scutata*
2	4	3	9		Pol	*Pectinaria auricoma*
2	4	3	9		Pol	*Lagis koreni*
indet.					Mol	Gastropoda indet.
					Mol	Bivalvia indet.
					Cru	Harpacticoida indet.
					Cru	Tanaidacea indet.
					Cru	Amphipoda indet.

species are known to live in association with amphiurids or sipunculids (Hayward & Ryland, 1990), and their numbers are correlated in some areas (Ockelmann & Muus, 1978) but not in others (Rosenberg, 1995). The presence of a large fraction of the *Mysella* population in deeper sediment layers suggests that this bivalve is not restricted to filter feeding but can also feed on deposit particles (Rosenberg, 1995). Most *Hyala vitrea* specimens were deeper than 5 cm and this species could be a predator (Moodley *et al*., 1998, Koulouri *et al*. 2006) and not a grazer, as classified in Macdonald *et al*. (2010). Polychaetes such as *Prionospio cirrifera*, *Eunice vittata* and *Lumbrineris latreilli* were recorded along the whole sediment profile and these species are very common in the sandy and pelitic bottoms of the northern Adriatic Sea (Aleffi *et al*., 2003).

Lee & Schwartz (1980) suggested a scheme of guilds of macrofauna depending on individual modes of feeding, mobility and position in and or the sediment. In this study, the taxa were coded and scored using the scheme of Swift (1993). The sum of the scores for each taxon ranked indicate that the sub-surface deposit feeders *Pectinaria auricoma, Pectinaria koreni* and *M. glebifex* have the greatest bioturbatory effects over the largest depth range, whereas the suspension feeders *C. gibba*, *V. aurea* and *Ampelisca* spp., among the most abundant, have a modest bioturbation in the surface layer.

Considering the relative abundance of each species, BA indicated that SDF polychaetes have a pivotal role in the bioturbatory activity in muddy sediment of the central area of the Gulf of Trieste, followed by SF molluscs if only the top layer is considered.

The results of this work suggest the following final remarks:

(1) The muddy sediment of the investigated area (central Gulf of Trieste) is normally inhabited down to 20 cm depth, with the exception of a sporadic presence of some very large specimens;

(2) The strata analysis of cores successfully investigated and explained the vertical zonation of macrofauna;

(3) The application of BA index to estimate the degree of bioturbation could also be a useful tool when grab-sampling techniques is applied. The availability of a larger dataset and the calculation of BA derived using the grab technique could provide a more detailed depiction of bioturbation for the northern Adriatic soft bottom sediments.

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VERTIKALNA DISTRIBUCIJA MAKROBENTOŠKIH ORGANIZMOV MEHKEGA DNA V TRŽAŠKEM ZALIVU (SEVERNO JADRANSKO MORJE)

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POVZETEK

Makrobentoški organizmi običajno veljajo za najpomembnejše povzročitelje bioturbacije v plitvih vodah, spodbujajo pa tudi premešavanje raztopljenih spojin in plinov med porno vodo in zgornjim slojem vodnega stolpca. Kot je omenilo že več avtorjev, se ta temeljni pojav najustrezneje opiše s preučevanjem vertikalne distribucije makrobentoških organizmov. V ta namen smo izbrali lokacijo v osrednjem delu Tržaškega zaliva (globina 21 m) in v letih 1999/2000 vzeli 9 vzorcev jedra vrtine v treh primerkih z največjo globino 20 cm. Pri opisu vertikalne distribucije makrobentoških združb smo upoštevali bioturbacijski indeks (BA). Iz vertikalne distribucije makrofavne je jasno razvidno, da se z upadom globine manjša tako število taksonov kot število osebkov. Indeks BA nakazuje, da imajo ključno vlogo pri bioturbaciji muljastih sedimentov površinski detritivorni mnogoščetinci, medtem ko v zgornjem sloju odigrajo pomembno vlogo suspenzivorni mehkužci. Če vzamemo v obzir vse rezultate, lahko trdimo, da je upoštevanje indeksa BA ob uporabi metode vzorčenja jedra vrtin lahko uporabno orodje pri opisu bioturbacije sedimentov na mehkem dnu severnega Jadrana.

Ključne besede: makrobentoški organizmi, vertikalna conacija, bioturbacijski indeks, prehranski cehi, Tržaški zaliv, Jadransko morje

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NEW RECORDINGS OF OPISTHOBRANCH MOLLUSKS (MOLLUSCA: OPISTHOBRANCHIA) IN THE SLOVENIAN PORTION OF THE ADRIATIC SEA

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ABSTRACT

Four opisthobranch species have been recorded in Slovenian coastal waters for the very first time: Tylodina perversa, Janolus cristatus, Eubranchus tricolor *and* Dicata odhneri. *The first three were to some extent expected.* D. odhneri *was found on two occasions, representing new data on this rather rare and less known nudibranch species. The total number of recorded opisthobranch gastropod species is now 70.*

Key words: Gastropoda, Opisthobranchia, new records, Slovenia, northern Adriatic

NUOVE SEGNALAZIONI DI MOLLUSCHI OPISTOBRANCHI (MOLLUSCA: OPISTHOBRANCHIA) NELLA PARTE SLOVENA DEL MARE ADRIATICO

SINTESI

Quattro specie di molluschi opistobranchi sono state segnalate per la prima volta per le acque costiere della Slovenia: Tylodina perversa, Janolus cristatus, Eubranchus tricolor e Dicata odhneri. *La presenza delle prime tre specie era in qualche modo prevista. La quarta specie,* D. odhneri, *piuttosto rara e poco conosciuta, è stata trovata in sole due occasioni. Il numero totale di specie di gasteropodi opistobranchi rinvenute nell'area sale così a 70.*

Parole chiave: Gastropoda, Opisthobranchia, nuove segnalazioni, Slovenia, Adriatico settentrionale

INTRODUCTION

Over course of the recent decade, some scientific papers were published concerning opistobranch mollusc species in the marine waters off Slovenia's coast. The most comprehensive work was published by Turk (2000), who listed the species of Opisthobranchia from the Adriatic Sea with particular focus on the portion controlled by Slovenia. He found 23 opisthobranch species in Slovenian waters. Later the same author (Turk, 2005) published a paper on a rare and less known *Cumannotus beaumonti* in the Punta Madona protected marine area in the waters off Piran. In 2008, Lipej and colleagues (Lipej *et al*., 2008) presented a checklist based on significant new data, complementing the checklist of Turk (2000).

During an ongoing research of cryptobenthic microhabitats in the Slovenian sea, certain opisthobranch mollusks that have apparently not been recorded in the area were sighted and photographed. The aim of this paper is therefore to present records of four as yet undocumented species in the Slovenian waters of the Gulf of Trieste.

MATERIAL AND METHODS

The four opisthobranch species were recorded at linear transects by means of occasional samplings in determined localities of the Slovenian coastal sea. Special attention was given to particular habitats and microhabitats where the specimens were recorded. All specimens were photographed and subsequently identified with the aid of identification keys and monographs such as Barletta (1980), Schmekel & Portmann (1982) and Trainito (2005).

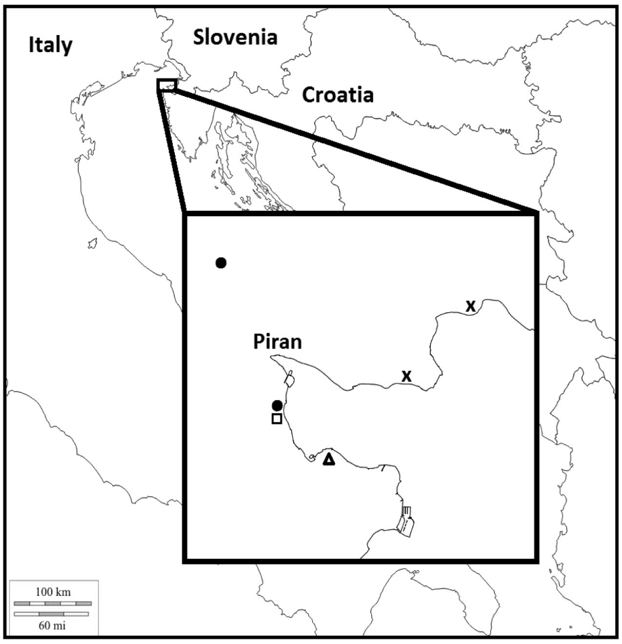

***Fig. 1: Localities where opisthobranchs were found in the Slovenian sea:* ● – *Eubranchus tricolor*, ▲ - *Janolus cristatus*, □ – *Tylodina perversa*, x – *Dicata odhneri*.**
***Sl. 1: Lokalitete, na katerih so bili najdeni zaškrgarji v slovenskem morju:* ● – *Eubranchus tricolor*, ▲ - *Janolus cristatus*, □ – *Tylodina perversa*, x – *Dicata odhneri*.**

RESULTS AND DISCUSSION

NOTASPIDEA
Family Tylodinidae
Tylodina perversa (Gmelin, 1791)

A specimen of *T. perversa* was found in the locality of Piranč™ek at the entrance to the town of Piran at the depth of 7.8 m on 8th July 2012 (Figs. 1, 2d). The specimen was recorded in the muddy habitat occurring at the edge of the rocky seabed. The species was easily recognized due to its typical umbrella-like shell. Its known distribution is in the Mediterranean Sea and northeast Atlantic Ocean at least as far as the British Isles. *T. perversa* feeds on the *Aplysina aerophoba* sponge. However, according to Becerro *et al*. (2003) the slug could also possibly feed also on the cyanobacteria that are present in high concentrations in the ectosome of the sponge. They found that the slugs actively choose sponges with a high concentration of cyanobacteria.

NUDIBRANCHIA
Family Proctonotidae
Janolus cristatus (Delle Chiaje, 1841)

One specimen of *Janolus cristatus* was found at a depth of 9 m at 30 June 2012 on the remains of an old car close to the tourist resort Bernardin (Figs, 1, 2c). The prevalent habitat type in the area is mud. Turk (2000) mentioned this species for the locality of Selca in Kvarner region, but otherwise it has been recorded from the Mediterranean to Norway. It is known to feed on erect bryozoans, especially *Bugula and Cellaria* species (Picton & Morrow, 2010).

Family Eubranchidae
Eubranchus tricolor Forbes, 1838

A specimen of *E. tricolor* was found on a sandy environment under the oceanographic buoy Vida on 16th March 2012 in waters off Piran. Two specimens were recorded on 23rd March 2012 at the locality of Pirančrek in the precoralligeneous habitat at 8 m (Figs. 1, 2a), and another one at the same location at a depth of 6 m. Turk (2000) found this species in the Kvarner region, close to the town of Sv. Juraj. *E. tricolor* is a boreal species, preferring lower temperatures and is known in the North-East Atlantic Ocean, from the Arctic to France. It is known to graze on both calyptoblastic and gymnoblastic hydroids and according to Rivers & Harris (1976) the preferred prey are species of the genus *Tubularia*.

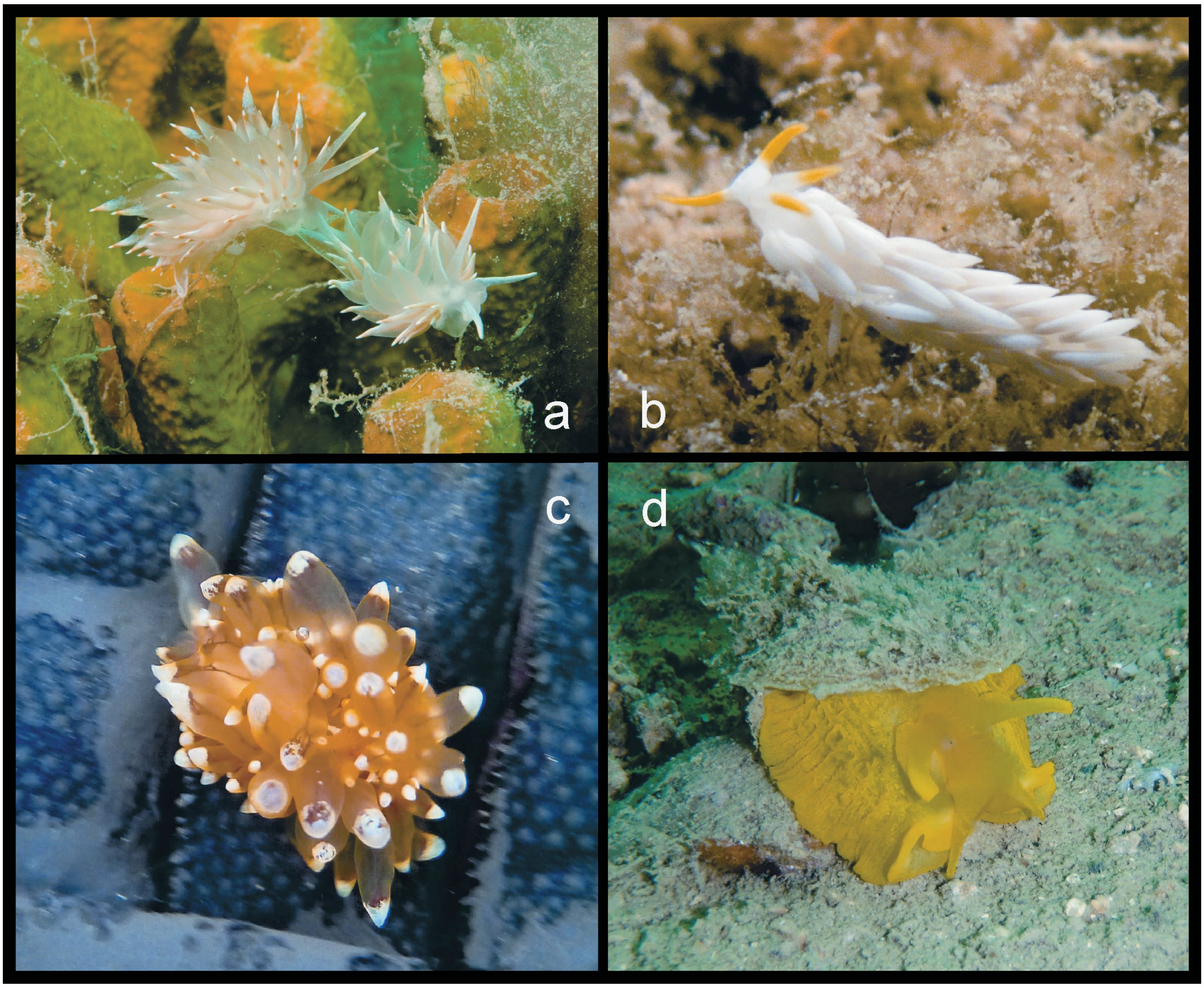

Fig. 2/Sl. 2: (a) *E. tricolor*, ***(b)*** *D. odhneri*, ***(c)*** *J. cristatus*, ***(d)*** *T. perversa*. ***(Photo/Foto: B. Mavrič: 2a, 2b, 2d; S. Moškon: 2c)***

Family Favorinidae
Dicata odhneri **Schmekel, 1967**

The first specimen of *Dicata odhneri* was found on algal turf at the locality of Salinera on 4th September 2009 at a depth of 3m. The second specimen was found at the locality of Mesečev zaliv on 12th July 2010 at 3.5 m (Figs. 1, 2b) in the biocoenosis of photophilic algae. The species is determined by its typical white colour and yellow rhinophores.

Opisthobranch fauna of Slovenia

Altogether, with the four new recorded seaslugs the checklist of opisthobranch fauna of Slovenia is enlarged to 70 species. Three of them were expected since they have previously been found in other parts of the Mediterranean Sea while *D. odhneri* has since its description in 1967 only been found in a few areas such as Gulf of Naples and in Atlantic waters of Baleal in Portugal (Silva, 2005) and Ireland (Picton & Morrow, 2010). However, since there are some additional unpublished records in other areas, the species is probably less rare than it appears to be.

Knowledge of the opisthobranch fauna of the Slovenian coastal sea will be certainly enlarged in the future. In fact, better inspection of the sampling area using new approaches together with the increased research effort could contribute to additional new findings for the area. The species list could be also enlarged by the arrival of southern thermophilous species and non-indigenous seaslugs.

NOVI PODATKI O POLŽIH ZAŠKRGARJIH (MOLLUSCA: OPISTHOBRANCHIA) V SLOVENSKEM DELU JADRANSKEGA MORJA

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POVZETEK

Avtorji poročajo o štirih vrstah polžev zaškrgarjev (Opisthobranchia), ki so bili prvič najdeni v slovenskem morju. To so: Tylodina perversa, Janolus cristatus, Eubranchus tricolor *in* Dicata odhneri. *Prve tri vrste so bile pričakovane, saj so bile potrjene v drugih bližnjih predelih. Vrsta* D. odhneri *je bila doslej najdena le na manjšem številu lokalitet, zato sta dva zapisa o pojavljanju te vrste v slovenskem morju nov doprinos k poznavanju te redke in manj znane vrste. Skupaj z novimi vrstami je sedaj število ugotovljenih vrst polžev zaškrgarjev v favni Slovenije 70.*

Ključne besede: Gastropoda, Opisthobranchia, novi podatki, Slovenija, severni Jadran

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BOTANICAL RARITIES FROM SLOVENIAN ISTRIA: THE INFLUENCE OF THE MEDITERRANEAN EDGE

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ABSTRACT

Eight (8) botanical rarities have been rediscovered within the last years in Slovenian Istria: two species, Opopanax chironum *and* Nepeta pannonica *tall herbs, which were neglected before due to a lack of botanical investigations, are present in a limited area of a very restricted vegetation belt. Two anthropophytes – the two* Adonis *species* (A. flammea, A. annua) *– are actually on the edge of extinction due to changed agricultural practices.* Ophrys bertolonii, Linaria angustissima *and* Trigonella gladiata *are typical cases for three Eu-mediterranean species, which occur here on the northern edge of their distributional ranges. They occur extensively in mowed grasslands* (Ophrys) *or in abandoned, now mixed scrub and stony grasslands. Only* Eryngium campestre *was found in strongly disturbed habitats; its occurrence should be classified as periodical. Thus, we should emphasise that the future of the botanical rarities discussed in this paper largely depends on human activities, which maintain a certain disturbance regime in the forms of ploughing, mowing or grazing.*

Key words: rare species, Istria, Slovenia, distributional ranges, habitat preferences

RARITÀ BOTANICHE DELL'ISTRIA SLOVENA: INFLUENZA DEL MARGINE MEDITERRANEO

SINTESI

Otto (8) rarità botaniche sono state rinvenute negli ultimi anni nell'Istria slovena. Due specie di erbe alte, che in passato sono state trascurate a causa della mancanza di indagini botaniche - Opopanax chironum e Nepeta pannonica - *sono presenti in una zona limitata di una fascia vegetazionale molto distinta. Due antropofite - due specie di* Adonis (A. flammea *ed* A. annua) *sono prossime all'estinzione a causa dei cambiamenti nelle pratiche agricole.* Ophrys bertolonii, Linaria angustissima e Trigonella gladiata *sono tre casi tipici di specie eu-mediterranee, che in questa zona vivono sul margine settentrionale del loro range di distribuzione. Tali specie crescono in praterie da falciare* (Ophrys) *o in abbandono, dove sono ora presenti macchia mista e praterie sassose. Solo* Eryngium campestre *è stata trovata in habitat fortemente disturbati e la sua presenza dovrebbe venir classificata come periodica. Gli autori pertanto rilevano che la gran parte delle rarità botaniche presentate nell'articolo dipende strettamente dalle attività umane, che mantengono un determinato regime di disturbo nelle forme di inserimento, falciatura o pascolo.*

Parole chiave: specie rare, Istria, Slovenia, range di distribuzione, preferenze di habitat

INTRODUCTION

Species distributional patterns are not random and follow geographic patterns that reflect both recent ecology and phylogeographic history (Avise, 2000). The Mediterranean flora is adapted to its Mediterranean environment, which is primarily characterised by its climate, followed by specific life forms and anatomical structured adapted to this environment (Wraber, 1993). However, the plants occurring in the Mediterranean area might be evolving under different regions and different conditions elsewhere (*e.g.* Thompson, 2005).

Although a part of Slovenia geographically belongs to the Mediterranean zone, many typical Mediterranean plants do not appear as part of its autochthonous flora (Wraber, 1993). In phytogeographic terms, the area of the Slovenian Sub-Mediterranean region, as defined by M. Wraber (1969), forms a contact area between the Mediterranean and Euro-Siberian biogeographic zone, having the characteristics of both zones; its natural vegetation type is deciduous forest (Kaligarič *et al*., 2006). It could be considered as a Supra-Mediterranean belt, constituted by various species of oak (Quézel & Médail, 2003), or a Sub-Mediterranean belt (Kaligarič, 1997).

More specifically, in addition to Euro-Mediterranean and Sub-Mediterranean zones, Šugar (1983) also recognises a Mediterranean-montane zone. The basis for this delineation is forest vegetation. The rough criterion is evergreen forest vegetation, dominated by deciduous oak and beech vegetation. On the basis of new research, the same author (Šugar, 1984) further elaborates the delineation of Istria as being on the edge of the Mediterranean basin. He distinguishes between the Mediterranean and Eurosibiric-North-American phytogeographic regions. The first region consists of three zones – Eu-Mediterranean, Sub-Mediterranean and Epi-Mediterranean. The second one consists of Para-Mediterranean and Illyric zones. The differences are grounded in a combination of delineations based on plant associations and chorological spectra of species from these associations.

Our investigated area consists mainly of Sub-Mediterranean and Para-Mediterranean zones. The chorological spectrum of the flora of the nearby Trieste karst could be defined as European in a broad sense (33 %), featuring Euro-Mediterranean (Sub-Mediterranean)-Illyrian-Pontic species (Poldini, 1989). There are different opinions about the level of "mediterraneity" of the flysch area of Slovenian Istria. Zupančič (1997) strongly supports the statement that its natural potential vegetation, which is deciduous forest, leads us to a conclusion that this area is far from being typically Mediterranean, referring also to palynological data of Šercelj (1981-1982) from the mouth of the Dragonja River.

The hypothesis that beech forests were natural potential vegetation also very close to the sea (in sites of present-day oak-forests) was proposed already by Piskernik (1985) and then supported with palynological evidences by Šercelj (1996). However, the strong anthropogenic influence over the last 2500 years, which created secondary dry grasslands, arable land, ruderal vegetation, etc, led the species composition in a much more thermophytic direction. Substantial vegetation changes were stated on the basis of pollen diagrams for Istria (Beug 1977). Later, in Roman times, species indicating farming activities proves the existence of agriculture associated with new settlements in Istria, but more interesting is the increase in the presence of evergreen trees (*Phillyrea*) (Beug, 1977). This can be taken as a sign that pioneer scrub and trees, which represent secondary succession, are regularly more thermophytic than the mesic primary forest. The primary forest creates and maintains mesic conditions with high humidity and lower temperature. These facts support the thesis proposed by Zupančič (1997). A scheme by Quézel (2004), which includes geological zonation, civilizations and vegetation types during the Holocene in southern France, also shows a transition between deciduous forests and evergreen sclerophytic forests about 5000 years BP. It was proposed by Kaligarič *et al*. (2006) that anthropogenic clearances in the karst terrain were necessarily associated with soil erosion, especially on slopes, and that they consequently create a dryer, warmer microclimate. This supports also the general conclusion, drawn by Eastwood (2004), which sees deforestation across the Mediterranean during the last 2000 years as having contributed to the aridity of the current climate.

The shift toward anthropogenically–driven thermophily probably includes shifts in species distributional patterns, especially at the edge of their distribution ranges. Therefore we should assume that the most thermophytic species, the Eu-Mediterranean species, are more linked to the secondary, disturbed habitats rather than to natural habitats. This argument is also supported by other authors, *e.g*., Plazar & Jogan (2001) or Jogan *et al*. (1999). They found thermophytic species, mainly annuals also in special conditions (*e.g*., along railways, street corridors) far outside the Sub-Mediterranean area. Mediterranean therophytes could establish temporarily or occasionally in disturbed dry habitats, but in the course of succession, they rarely persist for a longer period. In this study we record some new localities of rare species in Slovenia – all found in the territory of Slovenian Istria, which is the zone bordering the Mediterranean – and discuss their distributional ranges along with their habitat preferences.

MATERIAL AND METHODS

New localities of interesting species were identified during the course of field excursions, carried out in the years 2005, 2006, 2007 and 2008. The nomenclature for taxa follows Martinčič *et al*. (2007) and Aeschimann *et al*. (2004); for syntaxa, Poldini (1989).

RESULTS AND DISCUSSION

Ophrys bertolonii Moretti

On 25th May, 2006 one of the taxa from the aggregate *O. bertolonii* (Fig. 1) was found for the first time in Slovenian territory. According to old botanical data (Pospichal, 1897-99; Marchesetti, 1896-97), *O. bertolonii* never appeared in Istria northern of Rovinj other than in the sclerophilous evergreen Mediterranean vegetation belt. It was found in the relatively mesophytic karst meadows above the Kraški rob in the known botanical locality "Na Plasi" (370 m a.s.l.) near Podpeč. Only one exemplar was found in 2006, which didn't flower in 2007, but flowered again in 2008 and remained without flowers in 2009. The site was not visited between 2010 and 2012. On the surface of a few square metres around the plant, the following species has been recorded: *Achillea collina, Brachypodium rupestre, Bromus erectus, Coronilla coronata, Dorycnium pentaphyllum* subsp. *germanicum, Festuca rupicola, Hieracium cymosum, Onobrychis arenaria, Orchis morio, Lotus corniculatus, Melampyrum carstiense, Quercus pubescens, Pinus nigra, Rinanthus glacialis, Rhamnus rupestris, Sanguisorba minor* subsp. *minor, Scorzonera villosa.*

Fig. 1/Sl. 1: *Ophrys bertolonii.*

Opopanax chironium (L.) Koch

In 2006 and 2007, two localities of this species were found in the surroundings of Rakitovec. The tall umbelliferous plant was successfully flowering and producing fruits in the abandoned or recently mowed meadows within the Rakitovec plateau western of the village. Then, in 2007, more localities were found in the same plateau, but east of Rakitovec as far as the border with Croatia. It appears in mesic to moderately dry stands. Otherwise, this Mediterranean species, mostly distributed in the montane belt of the Dinarides, SW Alps, Apennines and Pyrenees, prefers the saum vegetation belonging to the association order *Galio-Alliarietalia*. The meadows, colonised by *Opopanax chironium* belong to the regularly mown meadows of *Arrrhanatheretum elatioris* and the Sub-Mediterranean-Illyrian semi-dry meadows of the *Danthonio-Scorzoneretum villosae* association. It is accompanied by the following species: *Knautia illyrica, Arrhenatherum elatior, Bromus erectus, Vicia cracca, Pastinaca sativa, Lathyrus latifolius, Salvia pratensis, Scorzonera villosa* and *Galium verum*. This is thought to be the only known population in Slovenia and comprises several thousand of exemplars. However, it will probably tend to spread further due to the abandonment of hay meadows in that altitudinal belt. According to the Slovenian red list, this species is "not sufficiently known", and its detailed conservational status has never been estimated. The only data available about its distribution in Slovenia refers to Pospichal (1897-99); he cites the localities of Černotiči, Rakitovec and Kavčice. It was also reported by Martini (2009) near Podpeč; however, the authors of this paper were not able to reconfirm it in this location.

Adonis flammea subsp. *cortiana* Jacq.

This thermophytic segetal terophyte, a rather common species in the past, was treated as already extinct (Wraber & Skoberne, 1989), but it was lately re-discovered by Wraber (1990) and Kaligarič (2001). This species was found near Krkavče above the Dragonja valley in 1989 and 1990 but after this time it was not reported as being present in those particular localities. It was again re-discovered near the village Krkavče in 2007 at the edge of a vegetable field in a vegetation stand 10 metres long and one metre wide, which could be easily classified as association *Galio tricornuti-Ranunculetum arvensis* where the following species were present: *Galium tricornutum, Ranunculus arvensis, Conslida regalis, Bifora radians, Legousia speculum-veneris, Anthirrhinum minus, Myagrum perfoliatum, Papaver rhoeas, Anthemis arvensis, Viola arvensis, Diplotaxis muralis, Chenopodium album, Anagalis arvensis, Rapistrum rugosum, Fallopia convolvolus, Veronica persica, Mercurialis annua* and *Kickxia spuria*. This stand developed in the absence of the main culture in which it usually appears –

wheat. It seems to be a spring-off of the seed bank that was previously accumulated within a now practically defunct wheat culture. This population was renewed over the course of two successional years: in 2007 there were 18 flowering exemplars, but the plants did not produced seeds. In 2008 only 2 exemplars remained, which produced fruits. It was not found any more in 2009. It could be concluded that this species will only sporadically appear in the future and that the seed bank will became impoverished in forthcoming years. In such cases "ex situ" conservation seems to be a suitable way to maintain its presence in the Slovenian flora.

***Adonis annua* subsp. *cupaniana* (Guss.) Steinberg**

This annual was also considered to be extinct in the red data book from 1989 (Wraber & Skoberne, 1989) but was re-discovered at Stena in Dragonja valley in 1989 (Wraber, 1990), an "island" of Eu-Mediterranean flora, surrounded with Sub-Mediterranean flora. It was found again only in 2007, but this time in the young olive grove growing near Krkavče. In the olive grove the following additional taxa were found: *Cirsium arvense, Anthemis arvensis, Myagrum perfoliatum, Sinapis arvensis, Sorghum halepense, Papaver rhoeas, Avena barbata, Vicia sativa, Conyza canadensis, Sonchus oleraceus* and *Fumaria officinalis*. Also in this case the occurrence of this rare annual was a spring-off from the seed bank, accumulated at the abandoned wheat field, which was converted to olive growing but ploughed in the previous year (2006), which activity created suitable conditions for the germination of this species. The exemplars produced many seeds in 2007 but since the olive grove was not ploughed in the autumn, no spring-offs occurred in the following year. Also in this case the ex-situ conservation, with occasional re-introductions in the proper habitats, should be the appropriate way to maintain the Slovenian population(s) in future.

***Nepeta pannonica* L.**

Pospichal (1897-99) cites many localities in Goriško region and in Brkini, but also near Krvavi Potok, Marija Snežna above Črni Kal and on mountains Kojnik and Kavčič. This species has not been recorded since then in the territory of Slovenia over a longer period. It was re-discovered in 2006; the localities above Rakitovec are between 680 and 750 m a.s.l. This perennial has Eastern-European and Western-Asiatic distribution; it appears on forest edges and in grasslands in reforestation, mainly within the *Onopordion acanthi* alliance. The population is not very large, consisting of not more than 50 exemplars, but it is stable and was able to be followed regularly every year.

***Linaria angustissima* (Loisel.) Borbas**

For this species only two localities had ever been previously recorded (Martinčič *et al*., 2007) – Ocizla and Černotiči; the latter probably refers to the same population as given in Pospichal (1897-99). This Mediterranean species was found in 2009 on the rocky grassland just by the road between Movraž and Rakitovec. A small population of around ten exemplars was flowering and already producing seeds. The finding of this species in the southern, very warm and dry part of Slovenian karst shows a typical pattern of periodic occurrence of Mediterranean annuals, which occasionally grow also beyond their typical distributional range.

***Trigonella gladiata* Steven ex M. Bieb.**

The only Slovenian locality of this Mediterranean annual is mentioned as being Podpeč near Črni kal (Martinčič *et al*, 2007), where species grows on dry grassland bellow the rocks in a very warm microclimate. This species was found under very similar conditions in 2009 (and confirmed in 2010 and 2011) in the calcareous hill in Hrastovlje (behind the church). The population seems to be quite large, since exemplars are not clustered together but scattered across the entire rocky grassland. The occurrence of this species follows the same distributional pattern as the previous one.

***Eryngium campestre* L.**

This xerophytic grassland species of eastern origin was found decades ago in the eastern Slovenia (Martinčič *et al.,* 2007), but it is very likely that it is not present here anymore. It was also found near Ljubljana in the past, but its occurrence is considered as secondary (Martinčič *et al*., 2007). It was found in 2008 and 2009 by the old road from Škofije to Rižana. Only a few exemplars were found, but successfully flowering and producing seeds. This is the first record of this species in the Sub-Mediterranean part of Slovenia, but we consider its occurrence as secondary. It is likely that the seeds were dispersed from Eastern Europe by tracks.

CONCLUSIONS

It could be summarized that only two species are clearly-detectable perennials, tall herbs, which were neglected due to lack of botanical investigations. However, those two – *Opopanax chironum* and *Nepeta pannonica* – are present in a limited area in a very distinguished vegetation belt in the upper zone of decidous oaks and lower zone of beech forests. Then, there are two anthropophytes – the two *Adonis* species, which are really on the edge of its extinction due to changed agricultural practices. *Ophrys bertolonii, Linaria angustissima* and *Trigonella gladiata* are typical cases

for three Eu-Mediterranean species, which occur here on the edge of their distributional ranges. Those species, however, do not occur in strongly disturbed habitats, but in extensively mowed grasslands (*Ophrys*) or in abandoned pastures, now mixed scrub and stony grasslands. Only *Eryngium campestre* was found in strongly disturbed habitats and its occurrence should be classified as not constant. In conclusion, we should emphasize that a great deal of botanical rarities discussed in this paper strongly depends on human activities, which keep certain disturbance regime in the forms of plugging, mowing or grazing. As stated also from previous authors (*e.g.* Wraber, 1975), flysch substrate can't sustain establishment and persistence of Eu-Mediterranean species in Slovenian litoral due to its properties (retaining water and lower temperature). Thus, the occurrence of Eu-Mediterranean species is limited to less permanent and disturbed (ruderal) stands, derived from human activities.

BOTANIČNE REDKOSTI IZ SLOVENSKE ISTRE: VPLIV SREDOZEMSKEGA ROBA

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POVZETEK

V zadnjih letih je bilo v slovenski Istri odkritih osem botaničnih redkosti: dve vrsti, visoki stebliki, sta bili doslej prezrti zaradi pomanjkanja botaničnih raziskovanj – Opopanax chironum *in* Nepeta pannonica – *prisotni sta na omejenem območju v določenem vegetacijskem pasu. Dva antropofita – dve vrsti iz rodu* Adonis (A. flammea, A. annua) – *sta na pragu lokalnega izumrtja zaradi spremenjene kmetijske prakse.* Ophrys bertolonii, Linaria angustissima *in* Trigonella gladiata *so trije tipični primeri evmediteranskih vrst, ki se tukaj pojavljajo na severnem robu svojega areala. Uspevajo na ekstenzivno gojenih traviščih* (Ophrys) *ali na opuščenih traviščih, danes grmiščih, in na kamnitih traviščih. Le vrsta* Eryngium campestre *je bila najdena v močno motenem habitatu in njeno pojavljanje lahko ocenimo kot periodično. Tako lahko zaključimo, da je večji del botaničnih redkosti, obravnavanih v tem članku, odvisen od človekovih dejavnosti, ki vzdržujejo stalno motnjo v obliki oranja, košnje ali paše.*

Ključne besede: redke vrste, Slovenija, areali, izbira habitata

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SINTESI

Palena è un piccolo Comune abruzzese sito in Provincia di Chieti il cui territorio è compreso nel Parco Nazionale della Majella. Nel presente lavoro si riporta l'elenco floristico di tutti i taxa presenti nel suo territorio comprendente 1201 entità. Di conseguenza su una porzione di territorio che rappresenta lo 0,03 % di quello di tutto lo stato italiano, è presente oltre il 15 % della sua flora. I contingenti floristici più rappresentati sono: l'Eurasiatico con 350 taxa, il Mediterraneo con 326 e l'Europeo con 241. Le nuove segnalazioni ammontano a 619 taxa mentre le entità endemiche e subendemiche a 104. Alcune importanti specie ivi presenti sono: Acer cappadocium *subsp.* lobelii, Malcolmia orsiniana, Papaver alpinum *subsp.* ernesti mayeri, Hieracium bifidum *subsp.* nummulariifolium, Hieracium hypochoeroides *subsp.* potamogetifolium, Hieracium bifidum *subsp.* nummulariifolium, Hieracium hypochoeroides *subsp.* potamogetifolium, Lathyrus pannonicus *subsp.* asphodeloides, Carex disitcha e Ophrys majellensis.

Parole chiave: flora, Palena, Chieti (Abruzzo)

REGISTER OF THE FLORA OF PALENA (ABRUZZO REGION AND MAJELLA NATIONAL PARK)

ABSTRACT

Palena is a small area located in Chieti's Province, Abruzzo Region and Majella National Park. In this paper, the checklist of all taxa recorded in the Palena territory is reported on. It comprises 1201 taxa, which equates to about 15 % of Italian flora despite the area representing only 0.03 % of the country's surface area. The most widespread floristic contingents are: the Eurasiatic with 350 taxa, the Mediterranean with 326 and the European with 241. The number of new taxa recorded in the area is 619 with the endemic and subendemic taxa amounting to 104. Some important registred taxa are: Acer cappadocium *subsp.* lobelii, Malcolmia orsiniana, Papaver alpinum *subsp.* ernesti mayeri, Hieracium bifidum *subsp.* nummulariifolium, Hieracium hypochoeroides *subsp.* potamogetifolium, Hieracium bifidum *subsp.* nummulariifolium, Hieracium hypochoeroides *subsp.* potamogetifolium, Lathyrus pannonicus *subsp.* asphodeloides, Carex disitcha *and* Ophrys majellensis.

Keywords: flora (local checklists), Palena (Chieti, Abruzzo)

INTRODUZIONE

Il territorio del Comune di Palena, tra i più estesi dell'intera provincia di Chieti, è caratterizzato da una notevolissima diversità di ambienti, spesso molto differenti tra loro a livello morfologico, geologico, climatico e quindi vegetazionale. Ci sono diversi studi di carattere floristico-vegetazionale, dove vengono indagati alcuni degli ambienti più rappresentativi del comprensorio palenese, dai Quarti di S. Chiara al versante orientale della Majella. In passato l'area in esame è stata studiata da: Tenore (1832), Cesati (1872), Abbate (1903), Feoli Chiapella (1979-1980), Tammaro (1986), Conti & Pellegrini (1988, 1990), Conti *et al*. (1990), Manzi (1992), Galetti (1995, 2008), Conti & Manzi (1997), Pirone (1997), Di Cecco (1999), Daiss & Daiss (1996), Blasi *et al*. (2005), Di Pietro *et al*. (2008), Gottlisch (2009), Griebl (2010), Wagensommer *et al*. (2010) e Di Cecco & Pezzetta (2012).

Il presente lavoro ha l'obiettivo di esaminare i precedenti studi condotti nell'area di interesse e di riportarne i dati di presenza, congiuntamente alle nuove segnalazioni fornite dagli autori, al fine di stilare una prima *checklist* di specie floristiche e ricavare da questa ulteriori approfondimenti di carattere quantitativo e qualitativo.

Inquadramento dell'area di studio

Palena è un piccolo centro della Provincia di Chieti ubicato nell'alta valle del fiume Aventino e alle pendici del versante sud-orientale del Monte Majella.

Il centro abitato è situato ad una altitudine di 767 m. s. l. m. mentre il suo territorio copre una superfice di 91.61 Kmq e si estende lungo l'asse NO-SE, dalla valle del Fiume Aventino, sino alle alture che circondano la Valle di Femmina Morta, morena di origine glaciale (Fig. 1), sita sul massiccio della Majella, dove in alcuni periodi dell'anno è presente un omonimo laghetto effimero, che si forma con lo scioglimento delle nevi.

Fig.1: Valle di Femmina Morta.
Sl. 1: Dolina Femmina Morta.

La quota più bassa del territorio comunale è di 603 m. Il versante orografico posto a destra del fiume Aventino raggiunge la quota massima di 2565 m s.l.m., presenta una morfologia piuttosto accidentata e si estende sul massiccio della Majella con il M. Porrara (2136 m) (Fig. 2) e la Tavola Rotonda m (2402 m) separati tra loro dal Guado di Coccia.

Il versante posto sulla sinistra idrografica dell'Aventino a sua volta è caratterizzato dal gruppo dei M. Pizzi, presenta una morfologia più dolce e quote meno elevate (Pietre Cernaie, 1783 m).

A cavallo tra questi due principali massicci è situato il valico della Forchetta (1269 m) che immette anche nel vasto altopiano carsico del Quarto di S. Chiara, estrema propaggine sud-occidentale della Provincia di Chieti a confine con quella dell'Aquila. Questo caratteristico pianoro altitudinale è attraversato dal torrente Vera che seguendo un percorso molto sinuoso confluisce verso un inghiottitoio carsico. Da qui l'acqua s'infiltra nel sottosuolo e dopo circa 72 ore di scorrimento sotterraneo, alcuni Km più a valle riaffiora in superfice dando origine ad importanti sorgenti poste ad est della dorsale del M. Porrara, tra cui quelle dell'Aventino. Quando il torrente

Fig. 2/Sl. 2: Monte Porrara.

alimentato dalle abbondanti piogge supera certe portate parte delle acque rimangono in superfice e si determina un allagamento periodico dell'area circostante. Da un punto di vista geo-litologico il territorio si presenta molto eterogeneo. Mentre nella parte orientale prevalgono formazioni argillose e arenacee, la parte a ridosso del M. Porrara e del massiccio della Majella, a sua volta, si caratterizza per la prevalenza di rocce e detriti calcarei.

In particolare il M. Porrara, insieme alla Majella e altri monti vicini rappresenta l'attuale testimonianza di un ambiente marino di piattaforma carbonatica del Meso-Cenozoico. Le formazioni argilloso-arenacee a loro volta sono depositi marini riferibili al Miocene e al Pliocene. L'altipiano di Quarto di S. Chiara è invece costituito da depositi fluvio-lacustri di origine quaternaria. Trattasi in particolare di depositi sabbiosi, ghiaiosi e conglomerati poco cementati intercalati a livelli torbosi.

Secondo la classificazione di Rivas Martinez (1996) il clima della fascia altitudinale in cui è posto il centro abitato rientra nel termotipo Mesotemperato superiore e ombrotipo Umido/Subumido che in ambito locale presenta le seguenti caratteristiche termo pluviometriche (Pezzetta, 1998) (vedi Figura 3):

- Precipitazioni medie annue: circa 990 mm (SD = 181)
- Precipitazioni mensili massime: novembre con 127 mm.
- Temperatura media annua giornaliera: 11,5 °C.
- Temperatura media del mese più caldo (luglio): 20,9 °C.
- Temperatura media del mese più freddo (gennaio): 4 °C.
- Escursione termica media annuale: 17 °C.

La fascia altitudinale compresa tra 900 e circa 1500 m d'altitudine rientra nel termotipo Collinare-Montano e ombrotipo Umido. Nell'ambito della flora appenninica è in genere caratterizzata da formazioni boschive che vanno dai querceti misti alle faggete vere e proprie. Nella fascia superiore compresa tra 1500 e 2200 m il termotipo è Montano-Subalpino e l'ombrotipo è Umido inferiore mentre la fascia oltre 2200 m d'altitudine appartiene al termotipo Orotemperato inferiore ed all'ombrotipo Iperumido inferiore. Un'altra caratteristica climatica del piano alpino magellense è data dalle intense nebbie e dai forti venti che facilmente possono raggiungere velocità superiori a 100 km/h.

L'area di Palena è caratterizzata da una variegata morfologia e da un'altrettanto notevole eterogeneità floristica. Gran parte del territorio comunale è ricoperto da boschi (54 % circa), pascoli naturali, praterie (21 % circa) ed estesi prati stabili (15% circa). Le restanti zone sono caratterizzate da coltivi, aree urbane ed incolti.

Alle quote inferiori del massiccio della Majella, in ambiti riparati e favorevolmente esposti, attecchiscono specie tipiche di ambienti caldi e soleggiati quali il leccio, l'acero minore, l'orniello, la roverella. Questo versante è anche il luogo elettivo per la crescita di varie Orchidacee termofile appartenenti soprattutto al genere *Ophrys*, particolarmente abbondanti lungo la strada ex statale 84 "Frentana" detta anche "la Tagliata" che come ricorda il nome taglia trasversalmente le pendici della Majella. Lungo il fiume Aventino, la vegetazione ripariale è rappresentata da salici, pioppi e ontani. Alla sua destra idrografica si rinvengono lembi di querceti rappresentati in prevalenza da cerro, cui si accompagnano altre latifoglie come il frassino, il tiglio e gli aceri, oltrechè specie a frutti carnosi come ciliegi, sorbi, meli e peri selvatici. Il piano montano si caratterizza per la dominanza della faggeta, che rappresenta oltre il 70 % dei boschi, con presenza nel sottobosco di agrifoglio, dafne e numerose geofite, e dove sporadicamente è riscontrabile anche il tasso (*Taxus baccata*). Tra le specie accessorie consociate al faggio va menzionato in particolare il raro acero di Lobel.

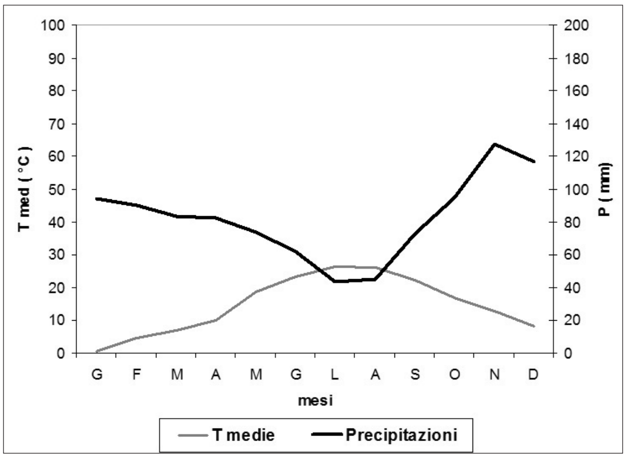

Fig. 3: Il climogramma di Palena.
Sl. 3: Klimogram občine Palena.

Sulle pendici meridionali del M. Porrara su inospitali pareti calcaree e in un ambito molto soleggiato e termofilo è presente un interessante nucleo di lecceta montana che ivi raggiunge quote considerevoli.

L'altopiano del Quarto di S. Chiara, a sua volta, presenta diverse formazioni erbacee legate a suoli più o meno umidi o impaludati. Si tratta di fitocenosi igrofile o mesofile a spiccato carattere relittuale, con entità floristiche molto rare tra cui *Carex buxbaumii*, *Carex disticha*, *Lathyrus pannonicus* subsp. *asphodeloides* e *Ranunculus marsicus*.

Nella fascia subalpina, al limite della vegetazione arborea, sono presenti piccoli nuclei di pino mugo, oltreché arbusteti a ginepro nano e uva orsina, mentre alle quote più elevate si alternano ambienti rocciosi, praterie primarie e secondarie e ambienti sommitali dove si rinvengono importantissime specie di carattere relittuale (es. *Silene acaulis* subsp. *bryoides, Aster alpinus*), specie endemiche ed altre incluse nelle liste rosse e protette.

MATERIALI E METODI

L'elenco floristico è stato realizzato tenendo conto:

- Delle ricerche sul campo degli autori;
- Dei campioni d'erbario dell'Ente Parco Nazionale della Majella (sigla utilizzata nel presente testo EPNM);
- Dei campioni d'erbario raccolti nella zona e conservati presso il Museo Friulano di Storia Naturale di Udine (sigla MFU);
- Dei contributi alle ricerche botaniche locali ricavati dalle consultazioni bibliografiche.

Per la nomenclatura dei vari taxa si è seguiti: Conti *et al*. (2005), Med check-list di Greuter *et al*. (1984-1989), per le Orchidaceae le indicazioni riportate nel recente volume sulle "Orchidee d'Italia" GIROS (2009). Per la ripartizione dei generi nelle famiglie e la relativa nomenclatura si sono seguite le indicazioni di APG III (2009) e Peruzzi (2010). Per specie nuova per il territorio di Palena s'intende un taxon che benchè talvolta comunissimo, in precedenza non è stato riportato nella letteratura botanica.

Inoltre si è ritenuto opportuno citare al fianco di ogni taxon i nominativi di coloro che lo hanno segnalato per la prima volta e riconfermato successivamente. Le segnalazioni di Blasi *et al*. (2005) si riferiscono al Fondo di Femmina morta che fa parte del Comune di Palena. Per l'assegnazione dei tipi biologici si è tenuto conto di Pignatti (1982). Per l'assegnazione dei tipi corologici si è tenuto conto di quanto riportato in Pignatti (1982), Poldini (1991) e Pezzetta (2010). Inoltre per varie entità, tenendo conto delle nuove segnalazioni e dell'attuale distribuzione geografica, si è operata una nuova definizione del corotipo di appartenenza. Per le entità alloctone si riportano tra parentesi le definizioni secondo Celesti--Grapow *et al*. (2010).

RISULTATI E DISCUSSIONE

Le ricerche effettuate hanno portato alla realizzazione del seguente elenco floristico.

PTERIDOPHYTA

EQUISETACEAE

1. *Equisetum arvense* L. subsp. *arvense*. -Circumboreale *
2. *Equisetum fluviatile* L. Circumboreale (Conti *et al.*, 1990)
3. *Equisetum palustre* L. Circumboreale *
4. *Equisetum ramosissimum* Desf. - Circumboreale *
5. *Equisetum telmateja* Ehrh. - Circumboreale *

OPHIOGLOSSACEAE

6. *Botrychium lunaria* (L.) Sw. - Subcosmopolita (Blasi *et al*., 2005; Di Fabrizio, 2006)

PTERIDACEAE

7. *Adiantum capillus - veneris* L. - Pantropicale *

POLYPODIACEAE

8. *Polypodium vulgare* L. - Circumboreale *

DENNSTAEDTIACEAE

9. *Pteridium aquilinum* (L.) Kuhn subsp. *aquilinum* - Cosmopolita. (G. Galetti, *info. pers.*) *

ASPLENIACEAE

10. *Asplenium trichomanes* L. subsp. *quadrivalens*. - Cosmopolita *
11. *Asplenium fissum* Kit. ex Willd. - Orofita Sud-Est Europeo *
12. *Asplenium lepidum* C. Presl subsp. *lepidum* - Orofita Sud-Est-Europeo *
13. *Asplenium ruta muraria* L. s. l. - Circumboreale *
14. *Asplenium viride Huds.* - Circumboreale *
15. *Ceterach officinarum* s.l. Willd. - Eurasiatico *

WOODSIACEAE

16. *Athyrium-filix-femina* (.L.) Bernh. - Cosmopolita *
17. *Cystopteris alpina* (Lam.) Desv. - Cosmopolita *
18. *Cystopteris fragilis* (L) Bernh. - Cosmopolita*

DRYOPTERIDACEAE

19. *Dryopteris filix mas* (L.) Schott - Cosmopolita. (G. Galetti, *info. pers.*) *
20. *Polystichum aculeatum* (L.) Roth - Eurasiatico *
21. *Polystichum lonchitis* (L.) Roth. - Circumboreale *
22. *Polystichum setiferum* (Forssk.) T. Moore exWoynar - Circumboreale *

GYMNOSPERMAE

PINACEAE

23. *Abies alba* Mill. - Orofita Sud-Europeo. (Alloctona naturalizzata) *
24. *Abies cephalonica* Loudon – Greco. (Alloctona naturalizzata) *
25. *Pinus mugo* Turra subsp. *mugo* – Eurasiatico *
26. *Pinus nigra* J. F. Arnold subsp. *nigra* Sud-Europeo. (Alloctona naturalizzata) *

CUPRESSACEAE

27. *Cupressus sempervirens* L. - Eurimediterraneo - (Alloctona naturalizzata) *
28. *Juniperus communis* L. subsp. *communis* - Circumboreale *
29. *Juniperus communis* L. subsp. *alpina* (Neilr.) Celak - Artico-Alpino. (Tammaro, 1986; Di Fabrizio, 2006)
30. *Juniperus oxycedrus* L. subsp. *oxycedrus* - Eurimediterraneo. (Tammaro, 1986)
31. *Juniperus sabina* L. - Circumboreale *

TAXACEAE

32. *Taxus baccata* L. Paleotemperato. (Tenore, 1832; Di Cecco,1999)

ANGIOSPERMAE

SALICACEAE

33. *Salix alba* L. subsp. *alba* - Paleotemperato *
34. *Salix apennina* Skvortsov - Emdemico. EPNM *
35. *Salix amplexicaulis* Bory - Appennino-Balcanico. EPNM *
36. *Salix capraea L.* - Eurasiatico *
37. *Salix eleagnos* Scop. Orofita Sud - Europeo *
38. *Salix purpurea* L. subsp. *purpurea* - Eurasiatico *
39. *Salix retusa* L. - Europeo *
40. *Salix triandra* L. subsp. *amigdalina* Schubl & G. Martens – Eurosiberiano. EPNM *
41. *Populus alba* L. - Paleotemperato. (Tammaro, 1986)
42. *Populus nigra* L. - Paleotemperato. (Tammaro, 1986)
43. *Populus tremula* L. - Eurosiberiano. (Tammaro, 1986)

JUGLANDACEAE

44. *Juglans regia* L. - Eurasiatico (Alloctona naturalizzata) *

BETULACEAE

45. *Alnus cordata* Loisel. (Loisel.) - Sud- Est-Europeo
46. *Alnus glutinosa* L. Gaertn. - Paleotemperato

CORYLACEAE

47. *Carpinus betulus* L. - Europeo *
48. *Carpinus orientalis* Mill. subsp. *orientalis* - Pontico *
49. *Corylus avellana* L. - Europeo *
50. *Ostrya carpinifolia* Scop. - Pontico

FAGACEAE

51. *Fagus sylvatica* L. subsp. *sylvatica* - Europeo
52. *Quercus cerris* L. - Eurimediterraneo
53. *Quercus ilex* L. subsp. *ilex* - Stenomediterraneo
54. *Quercus pubescens* Willd. subsp. *pubescens* - Pontico

ULMACEAE

55. *Ulmus glabra* Huds. - Europeo-Caucasico. (Di Cecco, 1999)
56. *Ulmus minor* Mill. subsp. *minor* - Europeo-Caucasico *

MORACEAE

57. *Ficus carica* L. - Eurimediterraneo (Alloctona naturalizzata) *
58. *Morus nigra* L. - Asiatico (Alloctona naturalizzata) *

URTICACEAE

59. *Urtica dioica* L. subsp. *dioica* - Cosmopolita *
60. *Urtica urens* L. - Subcosmopolita*
61. *Parietaria judaica* L. - Eurimediterraneo *
62. *Parietaria officinalis* L. - Europeo *

SANTALACEAE

63. *Osyris alba* L. - Eurimediterraneo
64. *Thesium linophyllon* L. subsp. *linophyllon* - Sud--Est-Europeo. (Griebl, 2010)
65. *Thesium divaricatum* Jan. - Eurimediterraneo. (Griebl, 2010)

LORANTHACEAE

66. *Loranthus europaeus* Jacq. - Europeo-Caucasico *
67. *Viscum album* L. subsp. *album* - Eurasiatico *

ARISTOLOCHIACEAE

68. *Aristolochia lutea* Desf. - Eurimediterraneo. (Tammaro, 1986)
69. *Aristolochia pallida* Willd. - Eurimediterraneo *

POLYGONACEAE

70. *Bistorta vivipara* (L.) Delarbre - Artico-Alpino
71. *Bistorta officinalis* L. - Circumboreale. (Tammaro, 1986)
72. *Persicaria amphibia* (L.) S. F. Gray - Subcosmopolita *
73. *Persicaria lapathifolia* (L.) Delarbre subsp. *lapathifolia* - Paleotemperato. (Tammaro, 1986)
74. *Polygonum aviculare* L. subsp. *aviculare* - Cosmopolita *
75. *Rumex acetosa* L. subsp. *acetosa* Circumboreale. (Tammaro, 1986)
76. *Rumex alpestris* Jacq. - Eurasiatico *

77. *Rumex conglomeratus* Murray - Eurasiatico. (Griebl, 2010)
78. *Rumex crispus* L . - Cosmopolita *
79. *Rumex nebroides* Campd. - Appennino-Balcanico *
80. *Rumex obtusifolius* Murray - Subcosmopolita *
81. *Rumex scutatus* L. subsp. *scutatus* – Mediterraneo - Montano. (Tammaro, 1986)

AMARANTHACEAE

82. *Amaranthus retroflexus* L. - Cosmopolita *
83. *Chenopodium album* L. subsp. *album* - Cosmopolita. (Tammaro, 1986)
84. *Chenopodium bonus- henricus* L. - Circumboreale. (Di Cecco, 1999)
85. *Chenopodium hybridun* L. - Circumboreale *

PORTULACACEAE

86. *Portulaca oleracea* L. subsp. *oleracea* - Subcosmopolita *

CARIOPHYLLACEAE

87. *Agrostemma githago* L. - Eurasiatico *
88. *Arenaria grandiflora* L. subsp. *grandiflora* - Mediterraneo - Montano *
89. *Arenaria serpyllifolia* L. subsp. *serpyllifolia* - Subcosmopolita *
90. *Cerastium arvense* L. subsp. *arvense* - Paleotemperato. (Di Fabrizio, 2006)
91. *Cerastium arvense* L. subsp. *suffruticosum* (L.) Ces. - Orofita Sud-Europeo. (Blasi *et al.,* 2005)
92. *Cerastium cerastioides* (L.) Britton - Artico-Alpino. (Blasi *et al*., 2005)
93. *Cerastium glomeratum* Thuill. - Eurimediterraneo. (Griebl, 2010)
94. *Cerastium glutinosum* Fries - Eurimediterraneo. (Griebl, 2010)
95. *Cerastium pumilum* Curtis - Eurimediterraneo. (Griebl, 2010)
96. *Cerastium thomasii* Ten. - Endemico. (Blasi *et al*., 2005; Di Fabrizio, 2006)
97. *Cerastium tomentosum* L. - Europeo-Occidentale. (Tammaro, 1986; Di Cecco, 1999)
98. *Dianthus carthusianorum* L. subsp. *tenorei* (Lacaita) Pignatti - Endemico *
99. *Dianthus ciliatus* Guss. subsp. *ciliatus* - Appennino-Balcanico *
100. *Dianthus deltoides* L. - Eurasiatico*
101. *Dianthus longicaulis* Ten. - Mediterraneo-Montano. (Di Fabrizio, 2006)
102. *Dianthus monspsessulanus* L. - Europeo *
103. *Dianthus sylvestris* Wulfen subsp. *sylvestris* - Mediterraneo-Montano. (Griebl, 2010)
104. *Drypis spinosa* L. subsp. *spinosa* - Appennino-Balcanico. (Di Cecco, 1999)
105. *Gypsophila repens L.* - Orofita Sud-Europeo *
106. *Heliospermum pusillum* (Waldst. & Kit.) Rchb. - Orofita Sud-Europeo. (Griebl, 2010)
107. *Herniaria bornmuelleri* Chaudhri - Endemico *
108. *Herniaria glabra* L. subsp. *nebrodensis* Jan ex Nyman - Endemico. (Blasi *et al*., 2005)
109. *Minuartia capillacea* (All.) Graebn. - Sud-Europeo. (Feoli Chiapella, 1979-80; Griebl, 2010)
110. *Minuartia glaucina* Dvoràkovà - Appennino-Balcanico *
111. *Minuartia graminifolia* (Ard.) Jav. subsp. *rosani* (Ten.) Mattf. - Endemico. (Galetti, 2008)
112. *Minuartia hybrida* (Vill.) Schinschkin - Paleotemperato *
113. *Minuartia verna* (L.) Hiern. subsp. *verna* - Eurasiatico. (Griebl, 2010)
114. *Paronykia kapela* (Hacq.) A. Kern. subsp. *kapela* - Appennino-Balcanico. (G. Galetti, *info. pers.*) *
115. *Pethroragia prolifera* (L.) P. W. Ball & Heywood - Eurimediterraneo. (C. Luciano, *info. pers.*) *
116. *Pethroragia saxifraga* (L.) Link subsp. *saxifraga* - Eurimediterraneo. (Griebl, 2010)
117. *Sagina glabra* (Willd.) Fenzl - Sud-Ovest-Europeo. Blasi *et al*. (2005), (Griebl, 2010)
118. *Saponaria bellidifolia* Sm. - Mediterraneo-Montano. (Griebl, 2010)
119. *Saponaria ocymoides* L. subsp. *ocymoides* - Mediterraneo-Montano. (Tammaro, 1986; Galetti, 1995)
120. *Saponaria officinalis* L. - Eurosiberiano *
121. *Silene acaulis* (L.) Jacq. subsp. *bryoides* (Jord.) Nyman - Artico-Alpino. (Feoli Chiapella, 1979-1980)
122. *Silene catholica* (L.) W. T. Aiton - Appennino-Balcanico. (Griebl, 2010)
123. *Silene conica* L. - Paleotemperato *
124. *Silene dioica* L. Clairv. - Paleotemperato *
125. *Silene flos-cuculi* (L.) Clairv. - Eurosiberiano *
126. *Silene italica* (L.) Pers. subsp. *italica* - Eurimediterraneo. EPNM *
127. *Silene latifolia* Poir. subsp. *alba* (Mill.) Greuter & Burdet - Paleotemperato. (Galetti, 1995)
128. *Silene multicaulis* Guss. subsp. *multicaulis* - Appennino-Balcanico. (Feoli Chiapella,1979-80; Di Fabrizio, 2006)
129. *Silene nemoralis* Waldst. & Kit. - Eurimediterraneo *
130. *Silene notarisii* Ces. - Endemico. (Galetti, 2008)
131. *Silene nutans* L. - Paleotemperato. (G. Galetti *info. pers.*) *
132. *Silene otites* (L.) Wibel subsp. *otites* - Eurasiatico *
133. *Silene saxifraga* L. - Orofita- Sud-Europeo. (Griebl, 2010)
134. *Silene* vulgaris (Moench) Garcke subsp. *prostrata* (Gaud.) Sch. & Th. - Orofita Sud-Ovest-Europeo. (Feoli Chiapella, 1979-80)
135. *Silene vulgaris* (Moench) Garcke subsp. *vulgaris* - Subcosmopolita. (Tammaro, 1986)
136. *Stellaria graminea* L. - Eurasiatico. (Griebl, 2010)

137. *Stellaria holostea* L. - Europeo-Caucasico *
138. *Stellaria media* (L.) Vill. subsp. media - Cosmopolita *
139. *Stellaria nemorum* L. s.l. - Europeo-Caucasico *

RANUNCULACEAE

140. *Aconitum lycoctonum* L. subsp. *neapolitanum* (Ten.) Nyman - Orofita-Sud-Europeo *
141. *Actaea spicata* L. - Eurasiatico. (Griebl, 2010)
142. *Anemone apennina* L. subsp. *apennina* - Sud-Est-Europeo *
143. *Anemone hortensis* L. subsp. *hortensis* - Mediterraneo-Settentrionale *
144. *Anemone narcissifolia* L. subsp. *narcissifolia* - Artico-Alpino *
145. *Anemonoides nemorosa* (L). Holub - Circumboreale. (Conti, 1987)
146. *Anemonoides ranunculoides* (L.) Holub - Europeo-Caucasico. (Galetti, 1995)
147. *Aquilegia atrata* Koch - Orofita-Sud-Ovest-Europeo. (Feoli Chiapella, 1979-1980; Tammaro, 1986; Galetti, 1995).
148. *Aquilegia vulgaris* L. - Paleotemperato**.** (Tammaro, 1986; Galetti, 1995; Griebl, 2010)
149. *Caltha palustris* L. - Circumboreale. (Tenore, 1832; Di Cecco, 1999; Galetti, 2008)
150. *Clematis flammula* L. - Eurimediterraneo *
151. *Clematis vitalba* L. - Europeo *
152. *Consolida regalis* S. F. Gray subsp. *regalis* - Eurimediterraneo. (L. Costantini *info. pers.*) *
153. *Delphinium fissum* Waldst. & Kit .subsp. *fissum* - Eurasiatico. (Tammaro, 1986)
154. *Eranthis hyemalis* (L.) Sails. - Sud-Europeo *
155. *Helleborus foetidus* L. subsp. *foetidus* - Subatlantico. (Tammaro, 1986; Griebl, 2010)
156. *Hepatica nobilis* Schreb. - Circumboreale. (Griebl, 2010)
157. *Nigella damascena* L. - Eurimediterraneo *
158. *Pulsatilla alpina* (L.) Delarbre subsp. *alpina* - Orofita Sud-Europeo *
159. *Ranunculus acris* L. subsp. *acris* - Cosmopolita *
160. *Ranunuculus apenninus* (Chiov.) Pignatti - Endemico. (Tammaro, 1986)
161. *Ranunculus arvensis* L. - Paleotemperato *
162. *Ranunculus brevifolius* Ten. - Appennino-Balcanico. (Griebl, 2010)
163. *Ranunculus breyninus* Crantz - Orofita Sud-Europeo. (Di Fabrizio, 2006)
164. *Ranunculus bulbosus* L. subsp. *bulbosus* - Eurasiatico. (Griebl, 2010)
165. *Ranunculus ficaria* L. subsp. *ficaria* - Eurasiatico *
166. *Ranunculus garganicus* Ten. Sud-Est-Europeo. (Tammaro, 1986)
167. *Ranunculus illyricus* L. - Pontico *
168. *Ranunculus lanuginosus* L. - Europeo-Caucasico *
169. *Ranunculus lateriflorus* DC. - Paleotropicale. (Pirone, 1997)
170. *Ranunculus marsicus* Guss. & Ten. - Endemico. (Di Cecco, 1999)
171. *Ranunculus millefoliatus* Vahl - Mediterraneo-Montano. (Tammaro, 1986)
172. *Ranunculus monspeliacus* subsp. *monspeliacus* - Mediterraneo-Montano. (G. Galetti, *info. pers.*) *
173. *Ranunculus neapolitanus* Ten. - Mediterraneo-Montano. (Tammaro, 1986)
174. *Ranunculus nemorosus* DC. - Eurosiberiano. (Griebl, 2010)
175. *Ranunculus polyanthemos* L. subsp. *polyanthemoides* (Boreau) Ahlfv - Sud-Europeo. EPNM *
176. *Ranunculus repens* L. - Paleotemperato *
177. *Ranuculus sardous* Crantz - Eurimediterraneo *
178. *Ranunculus sartorianus* Boiss. & Heldr. - Appennino-Balcanico. (Blasi *et al.*, 2005; Griebl, 2010)
179. *Ranunculus seguieri* Vill. subsp. *seguieri* - Mediterraneo-Montano. (Tammaro, 1986; Griebl, 2010)
180. *Ranunculus thora* L. - Orofita-Sud-Europeo *
181. *Ranunculus trichophyllus* Chaix subsp. *trichophyllus* - Europeo. (Conti, 1998; Griebl, 2010)
182. *Ranunculus velutinus* Ten. - Nord-Mediterraneo *
183. *Thalictrum aquilegifolium* L. - Eurosiberiano. (Griebl, 2010)
184. *Thalictrum foetidum* L. - Eurasiatico. (Griebl, 2010)
185. *Thalictrum minus* L. subsp. *minus* - Eurasiatico. (Griebl, 2010)
186. *Thalictrum simplex* L. subsp. *simplex* - Eurosiberiano. (Conti *et al.*, 1990)
187. *Trollius europaeus* L. subsp. *europaeus* - Artico--Alpino. (Di Cecco, 1999; Galetti, 2008; Griebl, 2010)

PAEONIACEAE

188. *Paeonia officinalis* L. subsp. *villosa* (Huth) Cullen & Heywood - Europeo-Caucasico. (Galetti, 1995; Di Cecco, 1999)

HYPERICACEAE

189. *Hypericum hirsutum* L. - Paleotemperato *
190. *Hypericum montanum* L. - Europeo-Caucasico *
191. *Hypericum perfoliatum* L. - Stenomediterraneo *
192. *Hypericum perforatum* L. – Eurimediterraneo. (G. Galetti, *info. pers.*) *
193. *Hypericum richeri* Vill. subsp. *richeri* - Orofita--Sud-Europeo *
194. *Hypericum tetrapterum* Fries - Paleotemperato *

PAPAVERACEAE

195. *Chelidonium majus* L. - Eurasiatico *
196. *Corydalis cava* (L) Schweigg. & Korte subsp. *cava* - Europeo-Caucasico. (Galetti, 1995)

197. *Fumaria officinalis* L. subsp. *officinalis*. - Paleotemperato *
198. *Papaver alpinum* L. subsp. *ernesti mayeri* Markgr. - Subendemico. (Di Cecco, 1999)
199. *Papaver apulum* Ten. Sud-Est-Europeo. (G. Galetti, *info. pers.*) *
200. *Papaver dubium* L. - Mediterraneo-Turaniano *
201. *Papaver rhoeas* L. subsp. *rhoeas* - Mediterraneo-Orientale *
202. *Pseudofumaria alba* (Mill.) Lidén subsp. *alba* - Appennino-Balcanico. (Griebl, 2010)

BRASSICACEAE

203. *Aethionema saxatile (*L.) R. Br. subsp. *saxatile* - Mediterraneo-Montano. (Griebl, 2010)
204. *Alliaria petiolata* (M. Bieb.) Cavara & Grande - Paleotemperato *
205. *Alyssum alyssoides* (L.) L. - Eurimediterraneo. (Griebl, 2010)
206. *Alyssum campestre* (L.) L. subsp. *strigosum* (Banks & Sol.) Jalas - Mediterraneo-Orientale *
207. *Alyssum cuneifolium* Ten. subsp. *cuneifolium* - Endemico *
208. *Alyssum montanum* L. subsp. *montanum* - Centro-Europeo. EPNM *
209. *Arabidopsis thaliana* (L.) Heynh. - Paleotemperato *
210. *Arabis alpina* L. subsp. *alpina* - Artico-Alpino. (Griebl, 2010)
211. *Arabis alpina* L. subsp. *caucasica* (Willd.) Briq. - Mediterraneo-Montano *
212. *Arabis collina* Ten. subsp. *collina* - Mediterraneo-Montano. (Griebl, 2010)
213. *Arabis hirsuta* (L.) Scop. - Europeo *
214. *Arabis pumila*. Jacq. subsp. *stellulata* (Bertol.) Nyman - Orofita Sud-Est-Europeo. (Feoli Chiapella, 1979-1980)
215. *Arabis sagittata* (Bertol.) DC. Sud-Est-Europeo *
216. *Arabis turrita* L. - Sud-Europeo *
217. *Arabis surculosa* N. Terracc. - Appennino-Balcanico. (Blasi *et al*., 2005)
218. *Aubrieta columnae* Guss. subsp. *columnae* - Endemico *
219. *Aurinia sinuata* (L.) Griseb. Mediterraneo-Montano. (Tammaro, 1986)
220. *Barbarea stricta* Andrz. - Eurosiberiano *
221. *Ballota nigra* L. subsp. *foetida* Hayek - Mediterraneo-Atlantico *
222. *Biscutella laevigata* L. subsp. *laevigata* - Orofita Sud-Europeo. EPNM *
223. *Brassica gravinae* Ten. - Endemico. EPNM *
224. *Brassica oleracea* (L.) - Mediterraneo-Atlantico *
225. *Bunias erucago* L. - Eurimediterraneo *
226. *Capsella bursa-pastoris* (L.) Medik. subsp. *bursa-pastoris* - Cosmopolita. (Tammaro, 1986)
227. *Capsella rubella* Reuter - Eurimediterraneo *
228. *Cardamine bulbifera* (L.) Crantz. - Pontico. (Tammaro, 1986)
229. *Cardamine graeca* L. - Appennino-Balcanico (G. Ciaschetti, *info. pers.*) *
230. *Cardamine enneaphyllos* (L.) Crantz - Appennino-Balcanico. (G. Galetti, *info. pers.*) *
231. *Cardamine hirsuta* L. - Cosmopolita *
232. *Cardamine kitaibelii* Beck. - Orofita Sud-Est-Europeo *
233. *Cardamine monteluccii* Brilli-Catt. & Gubellini - Endemico *
234. *Clypeola jonthlaspi* L. - Stenomediterraneo *
235. *Diplotaxis erucoides* (L.) DC. subsp. *erucoides* - Stenomediterraneo *
236. *Diplotaxis tenuifolia* (L.) DC. - Subatlantico *
237. *Draba aizoides* L. subsp. *aizoides* - Mediterraneo-Montano. (Griebl, 2010)
238. *Erophila verna* (L.) Chevall. subsp. *verna* - Circumboreale. (Tammaro, 1986)
239. *Erysimum cheiri* (L.) Crantz - Eurimediterraneo *
240. *Erysimum majellense* Polatscheck – Endemico. (Di Cecco, 1999; Griebl, 2010)
241. *Erysimum pseudorhaeticum* Polatscheck - Endemico. (Feoli Chiapella, 1979-1980; Tammaro, 1986; Di Fabrizio, 2006)
242. *Fibigia clypeata* (L.) Medik - Orofita Sud-Est-Europeo *
243. *Hesperis laciniata* All. - Mediterraneo-Montano. (Griebl, 2010)
244. *Hornungia petraea* (L.) Rchb. - Eurimediterraneo *
245. *Iberis saxatilis* L. subsp. *saxatilis* - Mediterraneo-Montano. EPNM *
246. *Isatis apennina* Ten. ex Grande - Subendemico. (presente in Italia e Francia) *
247. *Isatis tinctoria* L. subsp. *tinctoria* - Eurasiatico *
248. *Lepidium draba* L. subsp. *draba* - Eurimediterraneo *
249. *Lepidium campestre* (L.) R. Br. - Europeo-Caucasico *
250. *Lunaria annua* L. subsp. *annua* - Sud-Est-Europeo. (Griebl, 2010)
251. *Lunaria rediviva* L. - Europeo *
252. *Malcolmia orsiniana* (Ten.) Ten. subsp. *orsiniana* - Appennino-Balcanico (Griebl, 2010)
253. *Matthiola fruticulosa* (L.) Maire - Subendemico. Segnalata da Di Fabrizio (2006) come *Matthiola sinuata* e da attribuire alla specie.
254. *Rapistrum rugosum* (L.) Arcang. - Eurimediterraneo *
255. *Rorippa sylvestris* (L.) Besser subsp. *sylvestris* - Eurasiatico. EPNM *
256. *Sisymbrium officinale* (L.) Scop. - Paleotemperato *
257. *Thlaspi alliaceum* L. Mediterraneo-Atlantico *
258. *Thlaspi arvense* L. - Eurasiatico *
259. *Thlaspi perfoliatum* L. subsp. *perfoliatum* - Paleotemperato. (Tammaro, 1986)

260. *Thlaspi stylosum* (Ten.) Mutel - Endemico. (Di Cecco, 1999; Di Fabrizio, 2006)

RESEDACEAE

261. *Reseda lutea* L. subsp. *lutea* - Europeo *
262. *Reseda luteola* L. - Eurasiatico. (Griebl, 2010)

CRASSULACEAE

263. *Hylotelephium maximum* (L.) Holub - Centroeuropeo. (Griebl, 2010)
264. *Sedum acre* L. - Europeo-Caucasico. (Griebl, 2010)
265. *Sedum album* L. - Eurimediterraneo. (Tammaro, 1986; Galetti, 1995; Griebl, 2010)
266. *Sedum atratum L.* subsp. *atratum* - Mediterraneo-Montano *
267. *Sedum dasyphyllum* L. - Eurimediterraneo. (Galetti, 1995; Griebl, 2010)
268. *Sedum hispanicum* L. - Pontico. (G. Galetti, *info. pers.*) *
269. *Sedum magellense* Ten. subsp. *magellense* - Endemico. (Griebl, 2010)
270. *Sedum montanum* L. subsp. *montanum* - Mediterraneo-Montano *
271. *Sedum rupestre* L. subsp. *rupestre* - Europeo. (Griebl, 2010)
272. *Sedum sediforme* (Acq.) Pau - Stenomediterraneo. (G. Galetti, *info. pers.*) *
273. *Sedum sexangulare* L. -Europeo *
274. *Sempervivum arachnoideum* L. subsp. *arachnoideum* - Mediterraneo-Montano. (Di Cecco, 1999)
275. *Sempervivum riccii* Iber. & Anzal. - Endemico. (Sin. *Sempervivum italicum*) (Feoli Chiapella, 1979-1980)
276. *Sempervivum tectorum* L. - Orofita Sud-Ovest-Europeo *
277. *Umbilicus horizontalis* (Guss.) DC. - Stenomediterraneo *

SAXIFRAGACEAE

278. *Saxifraga adscendens* L. subsp. *adscendens* - Mediterraneo-Montano. (Tammaro, 1986)
279. *Saxifraga bulbifera* L. - Eurimediterraneo. (Griebl, 2010)
280. *Saxifraga caesia* L. - Mediterraneo-Montano. (Tammaro, 1986; Griebl, 2010)
281. *Saxifraga callosa* Sm. subsp. *callosa* - Orofita Sud-Ovest-Europeo. (Griebl, 2010)
282. *Saxifraga exarata* Vill. subsp. *ampullacea* (Ten.) D.A. Webb - Endemico. (G. Galetti, *info. pers.*) *
283. *Saxifraga granulata* L. subsp. *granulata* - Subatlantico *
284. *Saxifraga italica* D.A.Webb - Endemico*
285. *Saxifraga oppositifolia* L. subsp. *oppositifolia* - Artico-Alpino *
286. *Saxifraga paniculata* Mill. subsp. *paniculata* - Artico-Alpino. (Tammaro, 1986; Di Fabrizio, 2006)
287. *Saxifraga porophylla* Bertol. subsp. *porophylla* -Endemico. (Di Fabrizio, 2006; Griebl, 2010)
288. *Saxifraga rotundifolia* L. subsp. *rotundifolia* - Mediterraneo-Montano. (Griebl, 2010)
289. *Saxifraga sedoides* L. - Orofita Sud-Ovest-Europeo.*
290. *Saxifraga tridactylites* L. – Eurimediterraneo. (Griebl, 2010)

CELASTRACEAE

291. *Euonymus europaeus* L. - Erurasiatico. (Tammaro, 1986)
292. *Euonymus latifolius* L. (Mill.) - Mediterraneo-Montano. (Di Cecco,1999)
293. *Parnassia palustris* L. subsp. *palustris* - Eurosiberiano. (Tammaro, 1986)

GROSSULARIACEAE

294. *Ribes alpinum* L. - Eurosiberiano. (Di Cecco,1999)
295. *Ribes multiflorum.* Kit. - Mediterraneo-Montano. (Di Cecco,1999)
296. *Ribes uva-crispa* L. Eurasiatico *

ROSACEAE

297. *Agrimonia eupatoria* L. subsp. *eupatoria* - Subcosmopolita *
298. *Alchemilla alpina* L. Artico-Alpino. (Tammaro, 1986)
299. *Alchemilla colorata* Bus. - Eurasiatico *
300. *Alchemilla vulgaris* L. - Eurasiatico *
301. *Amelanchier ovalis* Medik. subsp. *ovalis* - Mediterraneo- Montano. (Tammaro, 1986; Griebl, 2010)
302. *Aremonia agrimonoides* (L.) DC. Stenomediterraneo. (Griebl, 2010)
303. *Cotoneaster integerrimus* Medik. - Eurasiatico *
304. *Crataegus monogyna* Jacq. subsp. *monogyna* - Paleotemperato. (Di Cecco,1999)
305. *Crataegus oxyacantha* L. - Centroeuropeo *
306. *Dryas octopetala* L. subsp. *octopetala* - Artico-Alpino. (Di Cecco,1999)
307. *Filipendula ulmaria* (L.) Maxim. subsp. *ulmaria* - Eurosiberiano. (Galetti, 2008)
308. *Filipendula vulgaris* Moench - Centro-Europeo *
309. *Fragaria vesca* L. subsp. *vesca* - Eurosiberiano. (Tammaro, 1986; Di Cecco, 1999; Griebl, 2010)
310. *Fragaria viridis* Duchesne subsp. *viridis* - Eurosiberiano *
311. *Geum rivale* L. - Circumboreale. (Conti, 1998; Galetti, 2008)
312. *Geum urbanum* L. - Eurasiatico *
313. *Malus domestica* (Borkh.) Borkh. - Asiatico (Alloctona naturalizzata) *

314. *Malus sylvestris* Mill. - Centroeuropeo. (Tammaro, 1986; Di Cecco, 1999)
315. *Potentilla apennina* Ten. - Appennino-Balcanico. (Griebl, 2010)
316. *Potentilla caulescens* L. - Mediterraneo-Montano. (Griebl, 2010)
317. *Potentilla crantzii (*Crantz) Beck ex Fritsch subsp. *crantzii* - Artico-Alpino. (Blasi *et al*., 2005; Griebl, 2010)
318. *Potentilla erecta* (L.) Rauschel - Eurasiatico *
319. *Potentilla hirta* L. - Eurimediterraneo. (L. Costantini, *info. pers.*) *
320. *Potentilla micrantha* Ramond. - Eurimediterraneo. (Tammaro, 1986)
321. *Potentilla recta* - Mediterraneo-Pontico. (G. Galetti, *info. pers.*) *
322. *Potentilla reptans* L. - Paleotemperato. (G. Galetti, *info. pers.*) *
323. *Potentilla rigoana* Th. Wolf - Endemico *
324. *Potentilla tabernaemontani* Asch. - Europeo. (Galetti, 2008)
325. *Prunus dulcis* (Mill.) D. A.Webb - Eurimediterraneo (Alloctona naturalizzata) *
326. *Prunus avium* L. subsp. *avium* - Pontico *
327. *Prunus cerasifera* Ehrh. - Pontico (Alloctona naturalizzata) *
328. *Prunus cerasus* L. Pontico (Alloctona naturalizzata) *
329. *Prunus domestica* L. s.l. - Europeo- Caucasico (Alloctona naturalizzata) *
330. *Prunus mahaleb* L. - Pontico *
331. *Prunus spinosa* L. subsp. *spinosa* - Europeo *
332. *Pyracantha coccinea* M. Roem. - Stenomediterraneo *
333. *Pyrus communis* L. - Origine ignota (Alloctona naturalizzata) *
334. *Pyrus pyraster* L. Eurasiatico. (Tammaro, 1986; Di Cecco, 1999)
335. *Rosa arvensis* Huds. - Mediterraneo-Atlantico. (Tammaro, 1986)
336. *Rosa canina* L. - Paleotemperato *
337. *Rosa pendulina* L. - Mediterraneo-Montano *
338. *Rosa dumalis* Bechst.- Europeo-Caucasico. (Tammaro, 1986; Galetti, 1995)
339. *Rosa montana* Chaix - Mediterraneo-Montano *
340. *Rubus caesius* L. Eurasiatico. (Tammaro, 1986)
341. *Rubus canescens* DC. - Eurimediterrano *
342. *Rubus hirtus* Waldst. & Kit. - Europeo *
343. *Rubus idaeus* L. - Circumboreale *
344. *Rubus saxatilis* L. Circumboreale *
345. *Rubus ulmifolius* Schott - Mediterraneo-Atlantico. (Tammaro, 1986)
346. *Sanguisorba minor* Scop. subsp. *muricata* (Gremli) Briq. - Paleotemperato. (Griebl, 2010)
347. *Sanguisorba officinalis* L. - Circumboreale. (Tammaro, 1986)
348. *Sorbus aria* (L.) Crantz subsp. *aria* - Paleotemperato. (Di Cecco, 1999)
349. *Sorbus aucuparia* L. subsp. *aucuparia* - Europeo. (Di Cecco, 1999)
350. *Sorbus domestica* L. - Eurimediterraneo *
351. *Sorbus torminalis* (L.) Crantz - Eurasiatico. (Di Cecco, 1999; Griebl, 2010)

FABACEAE

352. *Anthyllis montana* L. susbp. *atropurpurea* (Vuk.) Pignatti - Mediterraneo-Montano. (Feoli Chiapella, 1979-1980; Tammaro*,* 1986; Di Fabrizio, 2006)
353. *Anthyllis vulneraria* L. subsp. *maura* (Beck) Maire - Stenomediterraneo. (Griebl, 2010)
354. *Anthyllis vulneraria* L. subsp *pulchella* (Vis.) Born. - Sud-Est-Europeo *
355. *Anthyllis vulneraria* L. subsp. *rubiflora* (DC.) Arcang. - Eurimediterraneo. (Griebl, 2010)
356. *Astragalus australis* (L.) Lam. - Eurasiatico *
357. *Astragalus depressus* L. subsp. *depressus* - Pontico. (Griebl, 2010)
358. *Astragalus glycyphyllos* L. - Pontico. (Tammaro, 1986)
359. *Astragalus monspessulanus* L. subsp. *monspessulanus* - Eurimediterraneo *
360. *Astragalus sempervirens* Lam. - Mediterraneo-Montano. (Di Fabrizio, 2006)
361. *Bituminaria bituminosa* (L.) C. H. Stirt - Eurimediterraneo *
362. *Chamaecytisus spinescens* (C. Presl) Rothm. Appennino-Balcanico. (Tammaro, 1986)
363. *Chamaecytisus triflorus* (Lam.) Skalickà subsp. *triflorus* (Sin. *Chamaecytisus hirsutus*) Eurosiberiano. (Galetti, 1995)
364. *Colutea arborescens* L. - Eurimediterraneo *
365. *Coronilla minima* L. subsp. *minima* - Mediterraneo-Occidentale. (Griebl, 2010)
366. *Coronilla scorpioides* (L.) W. D. J. Koch - Eurimediterraneo *
367. *Coronilla vaginalis* Lam. - Sud-Est-Europeo. (Feoli Chiapella, 1979-1980; Tammaro, 1986)
368. *Cytisophyyllum sessilifolium* (L.) O. Lang - Sud-Ovest-Europeo. (Griebl, 2010)
369. *Cytisus decumbens* (Durande) Spach - Eurosiberiano. (Griebl, 2010)
370. *Cytisus villosus* Pourr. - Stenomediterraneo. (Tammaro, 1986)
371. *Dorycnium herbaceum* Vill. subsp. *herbaceum*. - Pontico. (Griebl, 2010)
372. *Dorycnium hirsutum* (L.) Ser. - Eurimediterraneo *
373. *Emerus majus* subsp. *emeroides* (Boiss. & Spruner) Soldano & F. Conti. Pontico *
374. *Galega officinalis* L. - Pontico *
375. *Genista sagittalis* L . - Europeo *
376. *Genista tinctoria L.* subsp. *tinctoria* - Eurasiatico. (Griebl, 2010)

377. *Hippocrepis comosa* L. subsp. *comosa* - Europeo. (Di Fabrizio, 2006; Griebl, 2010)
378. *Laburnum anagyroides* Medik. subsp *anagyroides* - Eurimediterraneo. (Di Cecco, 1999; Griebl, 2010)
379. *Lathyrus aphaca* L. subsp. *aphaca* - Eurimediterraneo. (Griebl, 2010)
380. *Lathyrus annuus* L. - Eurimediterraneo *
381. *Lathyrus cicera* L. - Eurimediterraneo*
382. *Lathyrus digitatus* (Bieb.) Fiori - Eurosiberiano. MFU *
383. *Lathyrus latifolius* L. Pontico *
384. *Lathyrus pannonicus* (Jacq.) Garcke subsp. *asphodeloides* - Eurosiberiano. (Di Cecco,1999; Griebl, 2010)
385. *Lathyrus pratensis* L. - Paleotemperato *
386. *Lathyrus sphaericus* Retz - Eurimediterraneo *
387. *Lathyrus sylvestris* L. subsp. *sylvestris* - Europeo-Caucasico *
388. *Lathyrus venetus (*Mill.) Wohlf. - Pontico *
389. *Lathyrus vernus* (L.) Bernh. - Eurasiatico. (Griebl, 2010)
390. *Lotus corniculatus* L.subsp. *alpinus* (DC.) Rothm. - Mediterraneo-Montano *
391. *Lotus corniculatus* L. subsp. *corniculatus* - Paleotemperato. (Di Cecco, 1999)
392. *Medicago arabica* (L.) Hudson - Eurimediterraneo *
393. *Medicago falcata* L. subsp. *falcata* - Eurasiatico. (Griebl, 2010)
394. *Medicago hispida* Gaertner - Eurimediterraneo. (Tammaro, 1986)
395. *Medicago lupulina* L. - Paleotemperato. (Griebl, 2010)
396. *Medicago minima* (L.) L. subsp. *minima* - Eurimediterraneo *
397. *Medicago orbicularis* (L.) Bartal. Eurimediterraneo *
398. *Medicago prostrata* Jacq. subsp. *prostrata* - Pontico *
399. *Medicago sativa* L. subsp. *sativa* - Eurasiatico *
400. *Melilotus albus* Med. - Eurasiatico *
401. *Melilotus officinalis* L. Pallas - Eurasiatico *
402. *Onobrychis* alba (Waldst. & Kit.) Desv. subsp. *alba* - Appennino-Balcanico. (Griebl, 2010)
403. *Onobrychis arenaria* subsp. *arenaria* (Kit.) DC. - Eurosiberiano. (Griebl, 2010)
404. *Onobrychis viciifolia* Scop. - Mediterraneo-Montano. Tammaro (1986), Griebl (2010)
405. *Ononis cristata* Mill. subsp. *apennina* Tammaro & Catonica - Endemico. (Griebl, 2010)
406. *Ononis pusilla* L. subsp. *pusilla* - Eurimediterraneo. (Griebl, 2010)
407. *Ononis spinosa* L. subsp. *spinosa* - Eurimediterraneo. (Tammaro, 1986)
408. *Oxytropis campestris* (L.) DC. subsp. *campestris* - Circumboreale. (Tammaro, 1986)
409. *Oxytropis neglecta* Ten. - Orofita- Sud-Europeo
410. *Pisum sativum* L. subsp. *biflorum* (Raf.) Soldano - Eurimediterraneo. (Griebl, 2010)
411. *Robinia pseudacacia* L.- Nordamericano - (Alloctona naturalizzata) *
412. *Securigera varia* (L.) Lassen - Sud-Est-Europeo. (Griebl, 2010)
413. *Spartium junceum* L. - Eurimediterraneo. (Griebl, 2010)
414. *Sulla coronaria* (L.) Medik. - Mediterraneo-Occidentale *
415. *Trifolium alpestre* L. - Europeo *
416. *Trifolium arvense* L. subsp. *arvense* - Paleotemperato *
417. *Trifolium campestre* Schreb. Paleotemperato. (Griebl, 2010)
418. *Trifolium fragiferum* L. subsp. *fragiferum* - Paleotemperato. (Tammaro, 1986)
419. *Trifolium medium* L. subsp. *medium* - Eurasiatico *
420. *Trifolium montanum* L. subsp. *rupestre* (Ten.) Nym. - Subendemico (Segnalato anche sulle Alpi Marittime in territorio francese). (Griebl, 2010)
421. *Trifolium nigrescens* Viv. subsp. *nigrescens* - Eurimediterraneo. (Tammaro, 1986)
422. *Trifolium pratense* L. subsp. *pratense* - Eurasiatico *
423. *Trifolium pratense* L. subsp. *semipurpureum* (Strobl) Pignatti - Endemico. (Blasi *et al*., 2005; Di Fabrizio, 2006)
424. *Trifolium repens* L. subsp. *repens* - Paleotemperato. (Di Fabrizio, 2006)
425. *Trifolium resupinatum* L. - Paleotemperato. (Tammaro, 1986)
426. *Trifolium stellatum* L. - Eurimediterraneo *
427. *Trifolium thalii* Vill. - Mediterraneo- Montano. (Di Fabrizio, 2006)
428. *Vicia cracca* L. subsp. *cracca* - Eurasiatico *
429. *Vicia narbonensis* L. subsp. *narbonensis* - Eurimediterraneo *
430. *Vicia onobrychioides* L. - Mediterraneo-Montano *
431. *Vicia ervilia (*L.) Willd. - Stenomediterraneo *
432. *Vicia sativa* L. subsp. *angustifolia* (Grufb.) Gaudin. - Mediterraneo-Turaniano. (Griebl, 2010)
433. *Vicia sativa* L. subsp. *sativa* - Eurimediterraneo *
434. *Vicia sepium* L. - Eurosiberiano. (G. Ciaschetti, *info. pers.*) *
435. *Vicia tenuifolia* Roth - Eurasiatico. (Griebl, 2010)
436. *Vicia villosa* Roth subsp. *varia* (Host) Corb. - Eurimediterraneo *

GERANIACEAE

437. *Erodium alpinum* L'Hér. - Endemico *
438. *Erodium ciconium* L'Hér.- Mediterraneo-Pontico *
439. *Erodium cicutarium* (L.) L'Hér. subsp. cicutarium - Cosmopolita *
440. *Erodium malacoides* (L.) L'Her. - Eurimediterraneo *
441. *Geranium austroapenninum* AEDO - Endemico. (Griebl, 2010)

442. *Geranium columbinum* L. - Eurosiberiano. (Griebl, 2010)
443. *Geranium dissectum* L. Eurasiatico *
444. *Geranium lucidum* L. - Eurimediterraneo. (Griebl, 2010)
445. *Geranium molle* L. - Eurasiatico. Segnalato da Tammaro (1986) come *Geranium brutium* Gasparr.
446. *Geranium nodosum* L. - Mediterraneo-Montano. (Feoli Chiapella, 1979-1980; Tammaro, 1986; Galetti, 2008; Griebl, 2010)
447. *Geranium reflexum* L. - Mediterraneo-Montano. (G. Galetti, *info. pers.*) *
448. *Geranium robertianum* L. - Cosmopolita, *
449. *Geranium rotundifolium* L. - Paleotemperato *
450. *Geranium sanguineum* L. - Europeo-Caucasico *
451. *Geranium sylvaticum* L. - Eurasiatico. (Galetti, 2008).
452. *Geranium versicolor* L. - Mediterraneo-Montano. (Feoli Chiapella, 1979-1980; Tammaro, 1986; Galetti, 2008).

LINACEAE

453. *Linum alpinum* Jacq. subsp. *julicum* - Mediterraneo-Montano. (Galetti, 1995)
454. *Linum austriacum* L. subsp. *tommasinii* (Rchb.) Greuter & Burdet - Appennino-Balcanico. (G. Galetti, *info. pers.*) *
455. *Linum bienne* Mill. - Eurimediterraneo. (G. Galetti, *info. pers.*) *
456. *Linum catharticum* L. - Eurimediterraneo *
457. *Linum capitatum* Kit. ex Schult. subsp. *serrulatum* (Bertol.) Hartvig - Appennino-Balcanico. (Griebl, 2010)
458. *Linum tenuifolium* L. - Pontico. (Galetti, 1995; Griebl, 2010)
459. *Linum tryginum* L. - Eurimediterraneo *
460. *Linum viscosum* L. - Orofita-Sud- Europeo. (Galetti, 1995; Griebl, 2010)

EUPHORBIACEAE

461. *Euphorbia amygdaloides* L. - subsp. *amygdaloides* - Europeo-Caucasico. (Tammaro, 1986; Griebl, 2010)
462. *Euphorbia characias* L. - Stenomediterraneo *
463. *Euphorbia cyparissias* L. - Europeo. (Tammaro, 1986; Griebl, 2010)
464. *Euphorbia helioscopia* L. subsp. *helioscopia* - Cosmopolita. (Tammaro, 1986)
465. *Euphorbia myrsinites* L. subsp. *myrsinites* - Pontico. (Tenore, 1832, Griebl, 2010)
466. *Euphorbia nicaensis* All. subsp. *nicaensis*. - Eurimediterraneo *
467. *Euphorbia platyphyllos* L. - Eurimediterraneo. (Griebl, 2010)
468. *Euphorbia samnitica* (Fiori) Tammaro (Sin. *Euphorbia gasparrinii*) - Endemico. (Di Cecco, 1999)
469. *Mercurialis annua* L. - Paleotemperato *
470. *Mercurialis ovata* Sternb. & Hoppe - Pontico. (Griebl, 2010)
471. *Mercurialis perennis* - L. Europeo. (Tammaro, 1986; Griebl, 2010)

RUTACEAE

472. *Ruta graveolens* L. Europeo *

SIMAROUBACEAE

473. *Ailanthus altissima* (Mill.) Swingle - Origine ignota (Alloctonana naturalizzata) *

POLYGALACEAE

474. *Polygala alpestris* Rchb. - Mediterraneo-Montano. (Blasi *et al.*, 2005; Di Fabrizio, 2006)
475. *Polygala amarella* Crantz - Europeo. (Galetti, 2008)
476. *Polygala major* Jacq. - Pontico. (Griebl, 2010)
477. *Polygala nicaensis* W. D. J. Koch subsp. *mediterranea* Chodat - Eurimediterraneo *
478. *Polygala vulgaris* L. Eurasiatico. (Galetti, 1995)

ANACARDIACEAE

479. *Pistacia terebinthus* L. subsp. *terebinthus* - Eurimediterraneo *

SAPINDACEAE

480. *Acer campestre* L. - Europeo-Caucasico *
481. *Acer monspessulanus* L. subsp. *monspessulanus* - Eurimediterraneo *
482. *Acer cappadocicum* Gled. subsp. *lobelii* (Ten.) Murray - Endemico. (Tammaro, 1986; Di Cecco, 1999).
483. *Acer opalus* Mill. subsp. *obtusatum* (Waldst. & Kit.) ex Willd. Gams - Appennino-Balcanico. (Di Cecco, 1999)
484. *Acer opalus* Mill. subsp. *opalus* Sud-Est-Europeo *
485. *Acer pseudoplatanus* L. - Europeo-Caucasico. (Di Cecco, 1999)

AQUIFOLIACEAE

486. *Ilex acquifolium* L. - Subatlantico. (Di Cecco, 1999; Griebl, 2010)

RHAMNACEAE

487. *Paliurus spina-christi* Mill. - Pontico *
488. *Rhamnus alpinus* L. - Mediterraneo-Montano. (Tammaro, 1986)

489. *Rhamnus cathartica* L. - Pontico *
490. *Rhamnus pumila* Turra - Mediterraneo-Montano. (Griebl, 2010)
491. *Rhamnus saxatilis* Jacq. - Sud- Est-Europeo *

MALVACEAE

492. *Alcea rosea* L. - Origine ignota (Alloctona naturalizzata) *
493. *Lavatera thuringiaca* L. subsp. *ambigua* (DC.) Nyman - Sud-Est- Europeo *
494. *Malva alcea* L. - Europeo. (G. Galetti, *info. pers.*) *
495. *Malva cretica* Cav. - Stenomediterraneo. (G. Galetti, *info. pers.*) *
496. *Malva moschata* L. - Eurimediterraneo *
497. *Malva neglecta* Wallr. - Paleotemperato. (G. Galetti, *info. pers.*) *
498. *Malva pusilla* Sm. - Eurosiberiano *
499. *Malva sylvestris* L. subsp. *sylvestris* - Eurosiberiano. (Tammaro, 1986; Di Cecco, 1999)
500. *Tilia cordata* Mill. - Europeo. (Tammaro, 1986; Di Cecco, 1999)
501. *Tilia platyphyllos* Scop. subsp. *platyphyllos* - Europeo *

THYMELAEACEAE

502. *Daphne laureola* L. - Subatlantico. (Griebl, 2010)
503. *Daphne mezereum* L. - Eurosiberiano. (Tammaro, 1986; Galetti, 1995)
504. *Daphne oleoides* Schreb. - Eurimediterraneo. (Di Cecco, 1999)

VIOLACEAE

505. *Viola alba* Besser subsp. *dehnardtii* (Ten.) W. Becker - Eurimediterraneo *
506. *Viola arvensis* Murray - Eurasiatico *
507. *Viola eugeniae* Parl .subsp. *eugeniae* - Endemico. (Tammaro, 1986; Di Fabrizio, 2006; Griebl, 2010)
508. *Viola majellensis* Porta & Rigo ex Strobl - Appennino-Balcanico. (Tammaro, 1986; Griebl, 2010)
509. *Viola odorata* L. - Eurimediterraneo *
510. *Viola riechenbachiana* Jord. ex Boreau - Eurosiberiano. (Griebl, 2010)
511. *Viola tricolor* L. subsp. *tricolor* - Eurasiatico *

CISTACEAE

512. *Cistus creticus* L. subsp. *eriocephalus* (Viv.) Greuter & Burdet - Stenomediterraneo *
513. *Fumana procumbens* (Dunal) Gren. & Godr. s. l. - Pontico*
514. *Fumana thymifolia* (L.) Spach ex Webb. - Stenomediterraneo *
515. *Helianthemum apeninum* (L.) Mill. subsp. *apenninum* - Sud-Ovest-Europeo. (Galetti, 1995; Griebl, 2010)
516. *Helianthemum canum* (L.) Baumg.subsp. *canum* - Europeo-Caucasico *
517. *Helianthemum nummularium* (L.) Mill. subsp. *glabrum* (Koch) Wilczek - Europeo-Caucasico *
518. *Helianthemum nummularium* (L.) Mill. subsp. *grandiflorum* (Scop.) Schinz & Thell. - Europeo-Caucasico. Galetti (1995), (Griebl, 2010)
519. *Helianthemum nummularium* (L.) Mill. subsp. *obscurum* (Celak) Holub - Europeo-Caucasico *
520. *Helianthemum oleandicum* (L.) Dum. Cours. subsp. *alpestre* (Jacq.) Ces. - Orofita-Sud-Europeo. (Griebl, 2010)
521. *Helianthemum oleandicum* (L.) Dum. Cours. subsp.*incanum* (Willk.) G. Lo - Europeo-Caucasico. EPNM *

CUCURBITACEAE

522. *Bryonia dioica* Jacq. - Eurimediterraneo *
523. *Ecballium elaterium* (L.) A. Rich. - Eurimediterraneo. (Tammaro, 1986)

LYTHRACEAE

524. *Lythrum salicaria* L. - Cosmopolita. (Tammaro, 1986)

ONAGRACEAE

525. *Circaea lutetiana* L. - Circumboreale *
526. *Epilobium alsinifolium* Vill. - Artico-Alpino *
527. *Epilobium angustifolium* L. - Circumboreale. (Galetti, 1995)
528. *Epilobium hirsutum* L. - Paleotemperato (Griebl, 2010)
529. *Epilobium montanum* L. - Eurasiatico *
530. *Epilobium palustre* L. - Circumboreale *
531. *Epilobium parviflorum* Schreber. - Paleotemperato. (G. Galetti, *info. pers.*) *

HALORAGACEAE

532. *Myriophyllum spicatum* L. - Subcosmopolita. (Conti *et al.*, 1990)

CORNACEAE

533. *Cornus mas* L. - Pontico. (Di Cecco, 1999; Griebl, 2010)
534. *Cornus sanguinea* subsp. *hungarica* (Kàrpàti) Soò - Eurasiatico *

ARALIACEAE

535. *Hedera helix* L. subsp. helix - Mediterraneo-Atlantico *

APIACEAE

536. *Angelica sylvestris* L. - Eurosiberiano *
537. *Anthriscus nitidus* (Wahlenb.) Garcke - Sud-Est-Europeo. (Griebl, 2010)
538. *Aegopodium podagraria* L. - Eurosiberiano *
539. *Anthriscus sylvestris* (L.) Hoffm. - Paleotemperato *
540. *Astrantia major* l.subsp. *elatior (*Friv.) K. Maly - Europeo-Caucasico. (Feoli Chiapella, 1979-1980; Griebl, 2010)
541. *Bunium bulbocastanum* L. - Ovest-Europeo. MFU *
542. *Bunium petraeum* Ten. Endemico *
543. *Bupleurum baldense* Turra subsp. *baldense* - Eurimediterraneo. (Griebl, 2010)
544. *Buplerum falcatum* L. subsp. *cernuum* (Ten.) Arcang. - Eurasiatico. EPNM *
545. *Buplerurum praealtum* L. - Pontico *
546. *Carum flexuosum* (Ten.) Nyman - Appennino- Balcanico *
547. *Carum heldreickii* Boiss. Appennino-Balcanico. (Tammaro, 1986)
548. *Chaerophyllum aureum* L. - Mediterraneo-Montano. (Di Cecco, 1999; Griebl, 2010)
549. *Chareophyllum hirsutum* L. subsp. *hirsutum* - Europeo-Caucasico *
550. *Chaerophyllum hirsutum* L. subsp. *magellense* (Ten.) Pignatti – Endemico *
551. *Chaerophyllum temulum* L. - Eurasiatico. (Tammaro, 1986; Griebl, 2010)
552. *Conium maculatum* L. subsp. *maculatum* - Eurimediterraneo *
553. *Caucalis platycarpos* L. - Mediterraneo-Turaniano *
554. *Daucus carota* L. subsp. *carota*. - Paleotemperato. (Di Cecco, 1999)
555. *Eryngium amethystinum* L. - Sud-Est-Europeo *
556. *Eryngium campestre* L. - Eurimediterraneo. (Tammaro, 1986)
557. *Foeniculum vulgare* Mill. subsp. *vulgare* - Eurimediterraneo *
558. *Heracleum sphondylium* L. subsp. *sibiricum* (L.) Simonk. - Paleotemperato. (Di Cecco, 1999)
559. *Laserptium latifolium* L. - Europeo. (Griebl, 2010)
560. *Laserpitium siler* L. subsp. *garganicum* (Ten.) Arcang. - Appennino-Balcanico. (Tammaro, 1986; Feoli Chiapella, 1979-1980; Griebl, 2010)
561. *Laserpitium siler* L. subsp. *siculum* (Spreng.) Santang. & Al. Endemico EPNM *
562. *Ligusticum lucidum* Mill. subsp. *cuneifolium* (Guss.) Tammaro - Endemico. (Griebl, 2010)
563. *Oenanthe fistulosa L.* - Eurasiatico. EPNM *
564. *Opopanax chironium* (L.) Koch - Stenomediterraneo. (Tammaro, 1986; Griebl, 2010)
565. *Orlaya daucoides* (L.) Greuter (Sin. *Orlaya kochii*) - Stenomediterraneo. (Tammaro, 1986)
566. *Orlaya grandiflora (*L.) Hoffm. Europeo *
567. *Pastinaca sativa* L. subsp. *urens* (Req. ex Godr.) Celak. - Subcosmopolita. (Tammaro, 1986)
568. *Pimpinella major* (L.) Huds. subsp. *major* - Europeo-Caucasico. (Tammaro, 1986)
569. *Pimpinella saxifraga* L. - Europeo *
570. *Pimpinella tragium* Vill. - Eurimediterraneo. (Tammaro, 1986)
571. *Sanicula europea* L. - Mediterraneo-Montano. (Griebl, 2010)
572. *Seseli libanotis* (L.) Koch - Pontico. (Tammaro, 1986; Di Fabrizio, 2006; Griebl, 2010)
573. *Seseli montanum* L. - Mediterraneo- Montano. (Griebl, 2010)
574. *Seseli tommasinii* Rchb, f. - Appennino-Balcanico *
575. *Tordylium apulum* L. - Stenomediterraneo *
576. *Torilis arvensis* (Huds.) Link – Subcosmopolita. (Tammaro, 1986)
577. *Trinia dalechampii* (Ten.) Janch. - Appennino-Balcanico. (Griebl, 2010)
578. *Trinia glauca* (L.) Dumort subsp. *carniolica* (Kerner) Wollf. – Appennino-Balcanico *

ERICACEAE

579. *Arctostaphylos uva-ursi* (L.) Spreng. - Artico-Alpino. (Di Cecco, 1999; Griebl, 2010)
580. *Orthilia secunda* (L.) House - Circumboreale *

PRIMULACEAE

581. *Anagallis arvensis* L. subsp. *arvensis* - Eurimediterraneo. (Tammaro, 1986; Galetti, 1995)
582. *Androsace villosa* L. subsp. *villosa* - Eurasiatico. (Di Fabrizio, 2006)
583. *Androsace vitaliana* (L.) Lapeyr . subsp. *praetutiana (*Sund.) Kress - Endemico *
584. *Cyclamen hederifolium* Aiton subsp. *hederifolium* - Stenomediterraneo. (Griebl, 2010)
585. *Cyclamen repandum* Sm. subsp. *repandum* - Nord-Mediterraneo. (Griebl, 2010)
586. *Primula auricula* L. subsp. *ciliata* (Moretti) Ludi - Mediterraneo-Montano *
587. *Primula elatior* (L.) subsp. *intricata* (Gren & Godron) Widmer. - Orofita Sud- Europeo. (Galetti, 2008)
588. *Primula* veris L. subsp. *suaveolens* (Bertol.) Gutermann & Ehrend. - Eurimediterraneo *
589. *Primula vulgaris* Huds. subsp. *vulgaris* - Europeo. (Tammaro, 1986; Griebl, 2010)

PLUMBAGINACEAE

590. *Armeria canescens (*Host) Boiss. subsp. *canescens* - Sud-Europeo. (Di Cecco, 1999; (Blasi *et al*., 2005)

591. *Armeria majellensis* Boiss. subsp. *majellensis* - Orofita Sud-Europeo *
592. *Plumbago europaea* L. - Stenomediterraneo *

OLEACEAE

593. *Fraxinus excelsior* L. subsp. *excelsior* - Europeo-Caucasico *
594. *Fraxinus ornus* L. subsp. *ornus* - Pontico. (Griebl, 2010)
595. *Ligustrum vulgare* L. - Europeo. (Di Cecco, 1999)
596. *Olea europaea* L. - Stenomediterraneo (Alloctona naturalizzata) *

GENTIANACEAE

597. *Blackstonia perfoliata* (L.) Huds. subsp. *perfoliata* - Eurimediterraneo *
598. *Centaurium erythraea* Rafn subsp. *erythraea* - Paleotemperato *
599. *Gentiana cruciata* L. - Eurasiatico. (Galetti, 1995)
600. *Gentiana dinarica* Beck - Appennino-Balcanico. (Tammaro, 1986; Di Fabrizio, 2006; Griebl, 2010)
601. *Gentiana lutea* L. subsp. *lutea* - Orofita Sud-Europeo. (Galetti, 1995)
602. *Gentiana magellensis* (Vaccari L.) Tammaro - Endemico *
603. *Gentiana nivalis* L. - Artico-Alpino. (Di Fabrizio, 2006)
604. *Gentiana tergestina* Beck - Appennino- Balcanico. (Feoli Chiapella, 1979-1980)
605. *Gentiana verna* L. subsp. *verna* - Eurasiatico. (Tammaro, 1986; Galetti, 1995; Di Fabrizio 2006)
606. *Gentianella columnae* (Ten.) Holub - Endemico. (Di Fabrizio, 2006)
607. *Gentianopsis ciliata* (L.) Ma subsp. *ciliata* - Mediterraneo-Montano *

APOCYNACEAE

608. *Vinca major* L. subsp. *major* - Eurimediterraneo. (Tammaro, 1986)
609. *Vinca minor* L. - Europeo-Caucasico *
610. *Vincetoxucum hirundinaria* Medik. subsp. *hirundinaria* - Eurasiatico. (Tammaro, 1986)

RUBIACEAE

611. *Asperula aristata* L. s.l. - Mediterraneo-Montano *
612. *Asperula cynanchica* L. - Eurimediterraneo *
613. *Asperula arvensis* L. Eurimediterraneo. (Griebl, 2010)
614. *Asperula purpurea* (L.) Ehrend. subsp. *purpurea* - Orofita Sud-Est-Europeo *
615. *Asperula taurina* L. - Orofita Sud-Est-Europeo. (Griebl, 2010)
616. *Cruciata glabra* L. - Eurasiatico. (Griebl, 2010)
617. *Cruciata laevipes* Opiz - Eurasiatico *
618. *Galium anisophyllon* Vill. - Mediterraneo-Montano *
619. *Galium aparine* L. - Eurasiatico *
620. *Galium bernardii* Gren. & Godron - Endemico. (Feoli Chiapella, 1979-80)
621. *Galium corrudifolium* Vill. - Stenomediterraneo. EPNM *
622. *Galium lucidum* All. subsp. *lucidum* - Eurimediterraneo. (Griebl, 2010)
623. *Galium magellense* Ten. - Endemico. (Di Fabrizio, 2006), (Griebl, 2010)
624. *Galium mollugo* L. subsp. *mollugo* - Eurimediterraneo *
625. *Galium odoratum* (L.) Scop.- Europeo-Caucasico *
626. *Galium palustre* L. - Europeo-Caucasico. (Tammaro, 1986)
627. *Galium rotundifolium* L. subsp. *rotundifolium* - Eurasiatico *
628. *Galium verum* L. subsp. *verum* - Eurasiatico. (Tammaro, 1986; Di Cecco, 1999; Griebl, 2010)
629. *Rubia peregrina* L. subsp. *peregrina* - Stenomediterraneo *
630. *Sherardia arvensis* L. - Eurimediterraneo *

CONVOLVULACEAE

631. *Calystegia sepium (*L.) R. Br. - Paleotemperato *
632. *Convolvulus arvensis* L. - Paleotemperato *
633. *Convolvulus cantabrica* L. - Eurimediterraneo (G. Galetti, *info. pers.*) *
634. *Cuscuta europaea* L. - Paleotemperato *
635. *Cuscuta planiflora* Ten. - Eurimediterraneo. (Tenore, 1832)

BORAGINACEAE

636. *Anchusa azurea* Mill. - Eurimediterraneo. (Griebl, 2010)
637. *Borago officinalis* L. - Eurimediterraneo *
638. *Buglossoides arvensis* (L.) I. M. Johnst. - Eurimediterraneo *
639. *Cynoglossum apenninum* L. Endemico *
640. *Cynoglossum magellense* Ten. - Endemico *
641. *Cynoglossum montanum* L. - Mediterraneo-Turaniano (G. Galetti, *info. pers.*) *
642. *Cynoglottiss barrellieri* (All.) Vural & Kit Tan. subsp. *barrellieri* - Appennino-Balcanico *
643. *Echium italicum* L. subsp. *italicum* - Eurimediterraneo. (Tammaro, 1986)
644. *Echium vulgare* L. subsp. *vulgare*. - Europeo *
645. *Heliotropium europaeum* L. - Eurimediterraneo. (Tammaro, 1986)
646. *Lithospermum officinale* L. - Eurosiberiano *
647. *Lithospermum purpurocaeruleum* L. (Sin. *Buglossoides purpurocaerulea*) - Pontico. (Griebl, 2010)

648. *Myosotis alpestris* F. W. Schmidt - Mediterraneo-Montano. (Griebl, 2010)
649. *Myosotis ambigens* (Bèg.) Grau - Endemico. (Blasi *et al*., 2005)
650. *Myosotis arvensis* Hill - Eurasiatico *
651. *Myosotis incrassata* Guss. - Appennino-Balcanico *
652. *Myosotis nemorosa* Besser - Eurasiatico. (Tammaro, 1986)
653. *Myosotis scorpioides* L. Europeo-Caucasico *
654. *Myosotis sylvatica* Hoffm. subsp. *sylvatica* - Paleotemperato. (Griebl, 2010)
655. *Onosma echioides* (L.) L. - Appennino-Balcanico (G. Galetti, *info. pers.*) *
656. *Pulmonaria apennina* Cristof. & Puppi - Endemico. (Griebl, 2010)

VERBENACEAE

657. *Verbena officinalis* L. - Paleotemperato *

LAMIACEAE

658. *Acinos alpinus* (L.) Moench subsp. *alpinus* - Orofita Sud-Europeo. (Tammaro, 1986; Di Cecco, 1999; Di Fabrizio, 2006)
659. *Acinos arvensis* (Lam.) Dandy - Eurimediterraneo *
660. *Ajuga chamaepytis* (L.) Schreb. subsp. *chamaepytis* - Eurimediterraneo *
661. *Ajuga reptans* L. - Europeo-Caucasico. (Galetti, 1995; Griebl, 2010)
662. *Ajuga tenorei* C. Presl. - Endemico *
663. *Ballota nigra* L. subsp. *meridionalis* (Bèguinot) Béguinot - Eurimediterraneo *
664. *Calamintha nepeta* (L.) Savi subps. *nepeta* - Mediterraneo-Montano *
665. *Clinopodium acinos* (L.) Kuntze - Eurimediterraneo *
666. *Clinopodium vulgare* L. subsp. *vulgare* - Circumboreale *
667. *Galeopsis angustifolia* Hoffm. subsp. *angustifolia* - Eurimediterraneo. EPNM *
668. *Galeopsis ladanum* L. - Eurasiatico *
669. *Galeposis tetrahit* L. - Eurasiatico *
670. *Hyssopus officinalis* L. subsp. *aristatus* (Godr.) Nyman - Eurasiatico *
671. *Lamium album* L. subsp. *album* - Eurasiatico. (Tammaro, 1986)
672. *Lamium amplexicaule* L. - Paleotemperato *
673. *Lamium flexuosum* Ten. - Mediterraneo-Montano. (Griebl, 2010)
674. *Lamium garganicum* L. subsp. *garganicum*. - Appennino-Balcanico. (Griebl, 2010)
675. *Lamium maculatum* L. - Eurasiatico (Griebl, 2010)
676. *Lamium purpureum* L. - Eurasiatico *
677. *Lamium galeobdolon* (L.) L. subsp. *montanum* (Pers.) Hayek - Europeo-Caucasico. (Griebl, 2010)
678. *Lycopus europaeus* L. subsp. *europaeus* - Paleotemperato *
679. *Marrubium incanum* Desr. - Sud-Est-Europeo. (Tammaro, 1986)
680. *Mentha arvensis* L. subsp. *austriaca* (Jacq.) Briq. - Circumboreale. (Manzi, 1992)
681. *Mentha longifolia* (L.) Huds. - Paleotemperato. (Griebl, 2010)
682. *Mentha spicata* L. - Eurimediterraneo. (Galetti, 2008)
683. *Melittis melissophyllum* L. subsp. *melissophyllum* - Europeo. (Griebl, 2010)
684. *Micromeria graeca* (L.) Benth. ex Rchb. subsp.*graeca* - Stenomediterraneo *
685. *Nepeta nuda L.* - Eurosiberiano. (Tammaro, 1986)
686. *Origanum vulgare* L . subsp. *vulgare* - Eurasiatico *
687. *Prunella laciniata* (L.) L. - Eurimediterraneo *
688. *Prunella vulgaris* L. - Circumboreale *
689. *Salvia glutinosa* L. - Eurasiatico *
690. *Salvia nemorosa* L. - Pontico *
691. *Salvia pratensis* L. subsp. *pratensis* - Eurimediterraneo. (Di Cecco, 1999).
692. *Salvia verbenaca* L. - Mediterraneo-Atlantico *
693. *Satureja montana* L. subsp. *montana* - Orofita--Sud-Europeo. (Griebl, 2010)
694. *Scutellaria alpina* L. - Eurasiatico. (Griebl, 2010)
695. *Scutellaria columnae* All. - Mediterraneo-Montano. (L. Costantini, *info. pers.*)
696. *Scutellaria galericulata* L. - Circumboreale. (Conti & Pellegrini, 1988; Galetti, 2008)
697. *Sideritis romana* L. subsp. *romana* - Stenomediterraneo *
698. *Sideritis syriaca* L. – Mediterraneo-Turaniano. (L. Costantini, *info. pers.*) *
699. *Stachys alopecuros* (L.) Bentham - Orofita-Sud-Europeo *
700. *Stachys annua* (L.) L. subsp. *annua* - Eurimediterraneo. (Griebl, 2010)
701. *Stachys germanica* L. subsp. *germanica* - Eurimediterraneo. (Tammaro, 1986)
702. *Stachys germanica* L. subsp. *heldreickii*. - Appennino-Balcanico. (Tammaro, 1986)
703. *Stachys germanica* L. subsp. *salviifolia* (Ten.) Gams. - Appennino-Balcanico. (Tammaro, 1986)
704. *Stachys officinalis* (L.) Trevisan subsp. *officinalis* - Europeo-Caucasico *
705. *Stachys recta* L. subsp. *recta* - Mediterraneo-Montano *
706. *Stachys sylvatica* L. - Eurosiberiano *
707. *Stachys thymphaea* Hausskn. - Appennino-Balcanico. (Tammaro, 1986)
708. *Teucrium botrys* L. - Eurimediterraneo*
709. *Teucrium chamaedrys* L. subsp. *chamaedrys* - Eurimediterraneo. (Tammaro, 1986)
710. *Teucirum flavum* L. subsp. *flavum* - Stenomediterraneo *

711. *Teucrium montanum* L. - Mediterraneo-Montano. (Di Fabrizio, 2006; Griebl, 2010)
712. *Teucrium polium* L. subsp. *capitatum* - Stenomediterraneo. (Tammaro, 1986)
713. *Thymus longicaulis* C. Presl subsp. *longicaulis* - Eurimediterraneo *
714. *Thymus oenipontanus* H. Braun - Orofita-Sud-Est-Europeo *
715. *Thymus pulegiodes* L. - Eurasiatico. (Griebl, 2010)
716. *Thymus praecox* Opiz subsp. *polytrichus* (Borbàs) Jalas - Appennino-Balcanico. (Di Fabrizio, 2006)
717. *Thumus thracicus* Velen (Sin. *Thymus longidens)* - Appennino-Balcanico. (Tammaro, 1986)
718. *Thymus vulgaris* L. subsp. *vulgaris* - Stenomediterraneo. (Galetti, 2008)

SOLANACEAE

719. *Atropa bella-donna* L. - Mediterraneo-Montano. (Di Cecco, 1999)
720. *Datura stramonium* L. subsp. *stramonium* - Cosmopolita *
721. *Hyoscyamus niger* L. - Eurasiatico *
722. *Solanum dulcamara* L. - Paleotemperato *

PLANTAGINACEAE

723. *Antirrhinum majus* Mill. - Mediterraneo-Occidentale *
724. *Chaenorrhinum minus* (L.) Lange subsp. *minus* - Eurimediterraneo. EPNM *
725. *Cymbalaria muralis* P. Gaertn., B. Mey & Scherb. subsp. *muralis* - Subcosmopolita. (Griebl, 2010)
726. *Cymbalaria pallida* (Ten.) Wettst. - Endemico. (Tammaro, 1986)
727. *Digitalis ferruginea* L. - subsp. *ferruginea* - Nord-Est-Mediterraneo *
728. *Digitalis lutea* L. subsp. *australis* (Ten.) Arcang. - Endemico. (Sin. *Digitalis micrantha*) (Tammaro, 1986; Galetti, 1995)
729. *Globularia bisnagarica* L. - Mediterraneo-Montano *
730. *Globularia meridionalis* (Podp.) O. Schwarz. - Appennino-Balcanico. (Di Fabrizio, 2006; Griebl, 2010)
731. *Linaria alpina* (L.) Mill. - Orofita- Sud-Europeo.*
732. *Linaria purpurea* (L.) Mill. - Endemico. (Tammaro, 1986; Di Cecco, 1999; Griebl, 2010)
733. *Linaria vulgaris* Mill. subsp. *vulgaris* - Eurasiatico *
734. *Misopates orontium* (L.) Raf. subsp. *orontium* - Eurimediterraneo *
735. *Plantago argentea.* Chaix subsp. *argentea* - Appennino-Balcanico. (Feoli Chiapella, 1979-1980)
736. *Plantago atrata* Hoppe subsp. *atrata* - Mediterraneo-Montano. (Blasi *et al*., 2005), Di Fabrizio, 2006; Griebl, 2010)
737. *Plantago atrata* Hoppe subsp. *fuscescens* (Jord.) Pilg. - Endemico *
738. *Plantago holosteum* Scop. - Sud-Est-Europeo. (Griebl, 2010)
739. *Plantago lanceolata* L. - Eurasiatico *
740. *Plantago major* L. subsp. *major* - Eurasiatico. (Tammaro, 1986; Griebl, 2010)
741. *Plantago media* L. subsp. *media* - Eurasiatico. (Griebl, 2010)
742. *Plantago sempervirens* Crantz - Eurimediterraneo *
743. *Veronica anagallis aquatica* L. - Cosmopolita *
744. *Veronica aphylla* L. - Orofita Sud- Europeo *
745. *Veronica arvensis* L. - Cosmopolita. (Tammaro, 1986)
746. *Veronica beccabunga* L. - Eurasiatico. (Galetti, 1995)
747. *Veronica chamaedrys* L. - Eurosiberiano. (Griebl, 2010)
748. *Veronica cymbalaria* Bodard - Eurimediterraneo. (Tammaro, 1986)
749. *Veronica hederifolia* L. subsp. *hederifolia* - Eurasiatico *
750. *Veronica montana* L. - Europeo. (G. Galetti, *info. pers.*)
751. *Veronica orsiniana* Ten. subsp. *orsiniana* - Orofita Sud-Europeo. (Griebl, 2010)
752. *Veronica persica* Poir. - Eurasiatico *
753. *Veronica polita* Fries - Paleotemperato *
754. *Veronoca prostrata* L. subsp. *prostrata* - Eurasiatico. (Galetti, 2008)
755. *Veronica serpyllifolia* L. - Eurasiatico *

SCROPHULARIACEAE

756. *Scrophularia canina* L. subsp. *bicolor* (Sm.) Greuter - Eurimediterraneo *
757. *Scrophularia hoppii* Koch – Orofita-Sud-Europeo. *
758. *Scrophularia nodosa* L. - Circumboreale EPNM *
759. *Scrophularia scopoli* Hoppe - Eurasiatico. EPNM *
760. *Scrophularia umbrosa* Dumort - Eurasiatico*
761. *Verbascum densiflorum* Bertol. - Eurimediterraneo. (Galetti, 1995)
762. *Verbascum longifolium* Ten. - Appennino-Balcanico. (Tenore, 1932; Griebl, 2010)
763. *Verbascum lychnitis* L. - Europeo-Caucasico*
764. *Verbascum mallophorum* Boiss. & Heldr. - Appennino-Balcanico. (Tammaro, 1986; Galetti, 1995)
765. *Verbascum nigrum* L. - Eurosiberiano. (Tammaro, 1986)
766. *Verbascum phlomoides* L. - Eurimediterraneo. (Tenore, 1832)
767. *Verbascum pulverulentum* Vill. - Europeo. (G. Galetti, *info. pers.*) *
768. *Verbascum thapsus* L. subsp. *thapsus* - Europeo. (Tammaro, 1986; Di Cecco, 1999)

OROBANCHACEAE

769. *Euphrasia italica* Wettst. - Endemico *
770. *Euphrasia minima* Iacq. Ex DC. - Centro-Europeo. (Blasi *et al*., 2005)
771. *Euphrasia salisburgensis* Funck ex Hoppe - Europeo. (Di Fabrizio, 2006)
772. *Lathraea squamaria* L. - Eurasiatico *
773. *Melampyrum italicum* Soò - Endemico *
774. *Melampyrum nemorosum* L. - Eurasiatico. (Griebl, 2010)
775. *Odontites luteus* (L.) Clairv. - Eurimediterraneo *
776. *Odontites rubra* (Baumg) Opiz - Eurasiatico *
777. *Odontites vulgaris* Moench subsp. *vulgaris* - Eurasiatico *
778. *Orobanche caryophyllacea* - Eurimediterraneo. (Griebl, 2010)
779. *Orobanche crenata* Forssk. - Eurimediterraneo *
780. *Orobanche gracilis* Sm. - Europeo-Caucasico. (Griebl, 2010)
781. *Parentucella latifolia Caruel* - Eurimediterraneo *
782. *Pedicularis comosa* L. subsp. *comosa* - Mediterraneo-Montano *
783. *Pedicularis elegans* Ten. - Endemico. (Di Fabrizio, 2006)
784. *Pedicularis hoermanniana* Maly - Appennino-Balcanico. (Griebl, 2010)
785. *Pedicularis petoliaris* Ten. - Appennino-Balcanico
786. *Rhinanthus alectorolophus* (Scop.) Pollich subsp. *alectorolophus* - Centro-Europeo. (Griebl, 2010)
787. *Rhinanthus minor* L. - Circumboreale. (Griebl, 2010)
788. *Rhinanthus wettsteinii* (Sterneck) Soò - Endemico. (Feoli Chiapella, 1979-1980; Tammaro, 1986)

CAPRIFOLIACEAE

789. *Centranthus angustifolius* (Mill.) DC. subsp. *angustifolius* - Mediterraneo-Occidentale. EPNM*
790. *Centranthus ruber* (L.) DC. subsp. ruber - Stenomediterraneo *
791. *Dipsacus fullonum* L. - Eurimediterraneo Tammaro (1986)
792. *Cephalaria leucantha* (L.) Roem. & Schult. - Eurimediterraneo *
793. *Knautia purpurea* (Vill.) Borbàs - Mediterraneo--Montano *
794. *Lomelosia crenata* (Cirillo) Greuter & Burdet subsp. *crenata* (Lacaita) Greuter & Burdet - Endemico. (Wagensommer *et al*., 2010)
795. *Lomelosia crenata* (Cirillo) Greuter & Burdet subsp. *pseusitenensis* (Lacaita) Greuter & Burdet - Endemico. (Wagensommer *et al*., (2010)
796. *Lomelosia graminifolia* subsp. *graminifolia* - Mediterraneo-Montano. (Di Fabrizio, 2006)
797. *Lonicera alpigena* L. Orofita-Sud-Europeo *
798. *Lonicera caprifolium* L. - Pontico. (Tammaro, 1986)
799. *Lonicera etrusca* Santi - Eurimediterraneo. (G. Galetti, *info. pers.*) *
800. *Scabiosa columbaria* L .subsp. *portae* (Huter) Hayek - Sud-Est-Europeo (G. Galetti, *info. pers.*) *
801. *Scabiosa triandra* L. - Eurosiberiano. (G. Galetti, *info. pers.*) *
802. *Scabiosa uniseta* Savi - Endemico *
803. *Valeriana montana* L. - Mediterraneo-Montano. (Griebl, 2010)
804. *Valeriana officinalis* L. - Europeo *
805. *Valeriana saliunca* All. - Endemico. (Di Fabrizio, 2006)
806. *Valeriana tripteris* L. subsp. *tripteris* - Mediterraneo-Montano *
807. *Valeriana tuberosa* L. - Mediterraneo-Montano *
808. *Valeriana wallrothii* Kreyer - Europeo. (Galetti, 2008; Griebl, 2010)
809. *Valerianella coronata* (L.) DC. - Eurimediterraneo *

ADOXACEAE

810. *Sambucus ebulus* L. Eurimediterraneo*
811. *Sambucus nigra* L. - Europeo *
812. *Viburnum lantana* L. - Centro-Europeo. (Griebl, 2010)

CAMPANULACEAE

813. *Campanula foliosa* Ten. - Orofita Sud-Est-Europeo. (Galetti, 2008)
814. *Campanula fragilis* Cirillo subsp. *cavolinii* Ten. - Endemico*
815. *Campanula glomerata* L. - Eurasiatico *
816. *Campanula persicifolia* L. - Eurasiatico. (L. Costantini Luciano, *info. pers.*) *
817. *Campanula rapunculus* L. - Paleotemperato. (Tammaro, 1986; Galetti, 1995; Griebl, 2010)
818. *Campanula scheuchzeri* Vill. subsp. *scheuchzeri* - Mediterraneo-Montano. (Blasi *et al*., 2005; Di Fabrizio, 2006)
819. *Campanula tanfanii* Podlech - Endemico *
820. *Campanula trachelium* L. - Paleotemperato. (Griebl, 2010)
821. *Edraianthus graminifolius* (L.) A. DC. subsp. *graminifolius* - Appennino-Balcanico. (Di Fabrizio, 2006)
822. *Legousia speculum-veneris* (L.) Chaix. Eurimediterraneo *
823. *Phyteuma orbiculare* L. - Mediterraneo-Montano. (Di Fabrizio, 2006; Griebl, 2010)

ASTERACEAE

824. *Achillea barrellieri* Ten subsp. *barrellieri* - Endemico. (Di Fabrizio, 2006)
825. *Achillea collina* Becker ex Rchb. - Sud-Est-Europeo *

826. *Achillea millefolium* L. subsp. *millefolium* - Eurosiberiano. (Tammaro, 1986)
827. *Achillea setacea* Waldst. & Kit. subsp. *setacea* - Sud-Est-Europeo. (Griebl, 2010)
828. *Achillea tenorii* Grande - Endemico. (Griebl, 2010)
829. *Adenostyles alpina* (L.) Bluff & Fingerh - Orofita Sud-Europeo. (Griebl, 2010)
830. *Adenostyles australis* (Ten.) Nyman - Mediterraneo-Montano. (G. Galetti, *info. pers.*) *
831. *Adenostyles glabra* (Mill.) DC. subsp. *glabra* - Orofita Sud-Europeo *
832. *Antennaria dioica* (L.) All. Circumboreale *
833. *Anthemis arvensis* L. subsp. *arvensis* - Subcosmopolita. (G. Galetti, *info. pers.*) *
834. *Anthemis cretica* L. subsp. *petraea* (Ten.) Oberprieler & Greuter - Endemico *
835. *Anthemis montana* L. Mediterraneo-Montano *
836. *Arctium lappa* L. - Eurasiatico *
837. *Arctium nemorosum* Lej & Court. - Eurasiatico *
838. *Artemisia absitnthium* L. - Subcosmopolita *
839. *Artemisia alba* Turra - Eurimediterraneo. (Tenore, 1832) come *Artemisia columnae,* (Griebl, 2010)
840. *Artemisa umbelliformis* Lam. subsp. *eriantha* (Ten.) Vallés-Xirau & Branas - Sud-Ovest-Europeo *
841. *Artemisia vulgaris* L. - Circumboreale *
842. *Aster alpinus* L. subsp. *alpinus* - Circumboreale. (Di Fabrizio, 2006)
843. *Bellis perennis* L. - Europeo-Caucasico. (Tammaro, 1986)
844. *Bellis pusilla* (Terrac.) Pignatti. Orofita Sud-Est-Europeo. (Tammaro, 1986)
845. *Bellis sylvestris* Cyr. - Stenomediterraneo (G. Ciaschetti, *info. pers.*) *
846. *Calendula arvensis* L. - Eurimediterraneo *
847. *Carduus acicularis* Bertol. - Mediterraneo-Montano. (Galetti, 2008)
848. *Carduus carlinifolius* Lam. - Mediterraneo-Montano. (Feoli Chiapella, 1979-1980; Tammaro, 1986)
849. *Carduus chrysacanthus* Ten. subsp. *chrysacanthus* - Appennino-Balcanico. (Di Cecco, 1999; Blasi *et al.*, 2005)
850. *Carduus corymbosus* Ten. - Endemico. (Galetti, 2008)
851. *Carduus nutans L.* subsp. *nutans* - Europeo-Occidentale. (G. Galetti, *info. pers.*) *
852. *Carduus pycnocephalus* L. subsp. *pycnocephalus* - Eurimediterraneo. Griebl (2010)
853. *Carlina acanthifolia* All. subsp. *acanthifolia.* Sud-Est-Europeo. (L. Costantini, *info. pers.*) *
854. *Carlina acaulis* L. subsp. *caulescens* (Lam.) Schubl. & G. Martens - Europeo *
855. *Carlina corymbosa* L. Stenomediterraneo *
856. *Carthamus lanatus* L. subsp. *lanatus* - Eurimediterraneo *
857. *Carlina vulgaris* L. subsp. *vulgaris* - Eurosiberiano*
858. *Centaurea ambigua* Guss. subsp. *ambigua* - Endemico *
859. *Centaurea ambigua* Guss. subsp. *nigra* - Endemico. (Tammaro, 1986)
860. *Centaurea calcitrapa* L. - Eurimediterraneo *
861. *Centaurea ceratophylla* Ten. subsp. *ceratophylla* - Endemico *
862. *Centaurea deusta* Ten. subsp. *splendens (*Arcang.) Matthas & Pignatti - Endemico. (Tammaro, 1986)
863. *Centaurea jacea* L. s.l. - Eurasiatico. EPNM *
864. *Centaurea scabiosa* L. subsp. *scabiosa* - Eurasiatico. EPNM *
865. *Centaurea solstitialis* L. subsp. *solstitialis* - Stenomediterraneo *
866. *Centaurea tenoreana* Willk. - Endemico. (Galetti, 2008)
867. *Chondrilla juncea* L. Eurosiberiano *
868. *Cichorium intybus* L. subsp. *intybus* - Paleotemperato *
869. *Cirsium acaule* (L.) Scop. subsp. *acaule* - Europeo-Caucasico. (G. Galetti, *info. pers.*) *
870. *Cirsium arvense* (L.) Scop. - Eurasiatico *
871. *Cirsium eriophorum* (L.) Scop. - Europeo. Griebl (2010)
872. *Cirsium lobelii* Ten. - Endemico. (Di Cecco, 1999)
873. *Cirsium oleraceum* (L.) Scop. - Eurosiberiano. (G. Galetti, *info. pers.*) *
874. *Cirsium tenoreanum* Petr. - Endemico *
875. *Cirsium vulgare* (Savi) Ten. - Paleotemperato *
876. *Cota tinctoria* (L.) J. Gaj subsp. *tinctoria* - Pontico *
877. *Crepis aurea* (L.) Cass. subsp. *glabrescens* (Caruel) Arcang. - Appennino-Balcanico. (Blasi *et al.*, 2005; Di Fabrizio, 2006)
878. *Crepis biennis* L. - Centro-Europeo *
879. *Crepis lacera* Ten. - Appennino-Balcanico. (Tenore, 1832; Di Cecco, 1999)
880. *Crepis neglecta* L. - Appennino-Balcanico *
881. *Crepis pygmaea* L. subsp. *pygmaea* - Orofita-Sud--Ovest-Europeo *
882. *Crepis sancta* (L.) Babc. subsp. *sancta* - Eurimediterraneo *
883. *Crepis setosa* Hall. - Eurimediterraneo. (Griebl, 2010)
884. *Crepis vesicaria* L. subsp. *vesicaria* - Mediterraneo- Atlantico. (L. Costantini, *info. pers.*) *
885. *Crupina vulgaris* Cass. - Eurosiberiano. (Griebl, 2010)
886. *Cyanus segetum* Hill - Stenomediterraneo *
887. *Cyanus triumfettii* (All.) Dostal ex A. & D. Love - Europeo. (Griebl, 2010)
888. *Doronicum columnae* Ten. - Mediterraneo-Montano. (Griebl, 2010)
889. *Echinops ritro* L. subsp. *ritro* - Stenomediterraneo *
890. *Echinops siculus* Strobl - Endemico. (G. Galetti, *info. pers.*) *
891. *Echinops spahaerocephalus* L. subsp. *albidus* (Boiss. & Spruner) Kozuharov - Paleotemperato. (Tammaro, 1986; Galetti, 2008)

892. *Erigeron bonariensis* L. - Origine ignota (Alloctona naturalizzata) *
893. *Erigeron epiroticus* (Vier.) Halàcsy - Appennino-Balcanico (Blasi *et al*., 2005; Griebl, 2010)
894. *Erigeron uniflorus* L. - Artico-Alpino *
895. *Eupatorium cannabinum* L. subsp. *cannabinum* - Paleotemperato *
896. *Gnaphalium hoppeanum* W. D. J. Koch subsp. *magellense* (Fiori) Strid - Appennino-Balcanico. (Blasi *et al*., 2005)
897. *Helichrysum italicum* (Roth) G. Don subsp. *italicum* - Eurimediterraneo *
898. *Helminthoteca echioides* (L.) Holub - Eurimediterraneo *
899. *Hieracium bifidum* Hornem, subsp, *nummulariifolium* Gottschl. - Endemico. (Gottschlich, 2009)
900. *Hieracium glaucum* All. subsp. *willdenowii* (Monn.) Naeg & Peter - Orofita Sud-Est- Europeo. (Feoli Chiapella, 1979-1980)
901. *Hieracium humile* Jacq. subsp. *brachycaule* Zahn - Appennino-Balcanico. (Gottschlich, 2009)
902. *Hieracium huetianum* Arv. Touv. – Appennino-Balcanico. (Gottschlich, 2009)
903. *Hieracium hypochoeroides* Gibson subsp. *potamogetifolium* Gottschl. - Endemico. (Gottschlich, 2009)
904. *Hieracium montis-porrarae*. Gottschl. - Endemico. (Gottschlich, 2009)
905. *Hieracium morisianum* Rchb. subsp. *villosiceps* Naeg & Peter. Orofita Sud-Est-Europeo.(Gottschlich, 2009)
906. *Hieracium pseudopallidum* Gottsch. - Endemico. (Gottschlich, 2009)
907. *Hieracium racemosum* Waldst. & Kit. ex Willd. subsp. *crinitum* (Mq.) Rouy. Orofita Sud-Est-Europeo. (Gottschlich, 2009)
908. *Hieracium racemosum* Waldst. & Kit. ex Willd. subsp. *pulmonarifolium* Gottschl. - Endemico. (Gottschlich, 2009)
909. *Hieracium murorum* L. subsp. *gypsophilum* (Griseb,) - Orofita Sud-Est-Europeo. (Feoli- Chiapella, 1982).
910. *Hieracium murorum* L. subsp. *subintegerrimum* Gottschl. - Endemico. (Gottschlich, 2009)
911. *Hieracium orodoxum* Gottlischl. - Endemico. (Gottschlich, 2009)
912. *Hieracium morisianum* Rchb- Orof-Sud- Est-Europeo. (Tammaro, 1986)
913. *Hieracium scorzonerifolium* Willd. subsp. *flexuosum* Nageli & Peter - Orofita Sud-Est-Europeo
914. *Inula conyzae* (Griess.) Meikle - Europeo *
915. *Inula helenium* L. - Orofita Sud-Est-Europeo*
916. *Inula hirta* L. - Eurosiberiano. (Griebl, 2010)
917. *Inula montana* L. - Mediterraneo-Montano *
918. *Inula salicina* L. - Europeo-Caucasico. (Griebl, 2010)
919. *Jacobaea alpina* (L.) Moench - Centro-Europeo
920. *Jacobaea samnitum* (Nyman) B. Nord & Greuter - Endemico. (Di Cecco, 1999)
921. *Jurinea mollis (*L.) Rchb. subsp. *mollis* - Sud-Est--Europeo *
922. *Lactuca perennis* L. - Eurimediterraneo. (Griebl, 2010)
923. *Lactuca serriola* L. - Eurosiberiano *
924. *Lactuca viminea* (L.) J. & C. Presl. subsp. *viminea* - Eurimediterraneo *
925. *Lapsana communis* L. - Paleotemperato. (G. Ciaschetti, *info. pers.*) *
926. *Leontodon autumnalis* L. subsp. *autumnalis* - Paleotemperato. (Tammaro, 1986)
927. *Leontodon crispus* Vill. subsp. *asper* - Eurimediterraneo. (Griebl, 2010)
928. *Leontodon hispidus* L. Europeo. (Griebl, 2010)
929. *Leontopodium nivale* (Ten.) Huet ex Hand.-Mazz. - Appennino-Balcanico. (Di Cecco, 1999)
930. *Leucanthemum ceratophylloides* (All.) Nyman subsp. *tenuifolium* - Endemico. (Galetti, 2008)
931. *Leucanthemum tridactylites* (Kern. & Huter) Huter, Porta & Rigo - Endemico. (Di Fabrizio, 2006)
932. *Leucanthemum vulgare* Lam. subsp. *vulgare* - Eurimediterraneo. (Di Cecco, 1999)
933. *Matricaria chamomilla* L. - Subcosmopolita (Alloctona naturalizzata) *
934. *Matricaria inodora* L. - Europeo. (Galetti, 2008) *
935. *Mycelis muralis* (L.) Dum. - Europeo-Caucasico *
936. *Onopordum acanthium* L. Mediterraneo-Montano *
937. *Onopordum Illyricum* L. subsp. *illyricum* - Stenomediterraneo *
938. *Pallenis spinosa* (L.) Cass. subsp. *spinosa* - Eurimediterraneo. (Tammaro, 1986)
939. *Petasites albus* (L.) Gaertn. - Europeo *
940. *Petasites hybridus* (L.) P. Gaertn. B. Mey. & Scherb. subsp. *hybridus* - Eurasiatico *
941. *Picris hieracioides* L. subsp. *hieracioides* - Eurosiberiano *
942. *Pilosella anchusoides* Arv. Touv. - Orofita Sud-Ovest-Europeo. (Gottlisch, 2009)
943. *Pilosella hoppeana* (Schult) F. W. Schult & Sch. Rur subsp. *macrantha* (Ten.) S. Braut & Greuter (Sin. *Hieracium macranthum*) - Mediterraneo-Montano. (Tammaro, 1986)
944. *Pilosella hypeurya* (Peter) Soyak. Orofita Centro-Europeo. (Gottlisch, 2009)
945. *Pilosella officinarum* Vaill. (Sin. *Hieracium pilosella)* - Europeo. (Blasi *et al*., 2005, Gottschlich, 2009)
946. *Pilosella piloselloides* (Vill.) Sojak (Sin. *Hieracium piloselloides*) - Europeo. (Gottlisch, 2009)
947. *Pilosella ziziana* (Tausch) Schultz & Sch. Rip. (Sin. *Hieracium zizianum*) - Europeo. (Gottlisch, 2009)
948. *Podospermum canum* C. A. Meyer - Eurosiberiano *
949. *Prenanthes purpurea* L. - Europeo. (Griebl, 2010)
950. *Ptilostemon strictus* (Ten.) Greuter - Appennino-Balcanico *

951. *Pulycaria dysenterica* (L.) Bernh. - Eurimediterraneo *
952. *Reichardia picroides* (L.) Roth. Stenomediterraneo *
953. *Rhagadiolus stellatus* (L.) Gaertn. - Eurimediterraneo *
954. *Robertia taraxocoides* (Loisel.) DC. - Endemico *
955. *Scolymus hispanicus* L. - Eurimediterraneo *
956. *Scorxonera laciniata* L. subsp. *laciniata* - Paleotemperato *
957. *Scorzoneroides montana* (Lam.) Holub subsp. *breviscapa* (DC.) Greuter. - Orofita Sud-Est-Europeo *
958. *Scorzoneroides montana* Lam.) Holub subsp. *montana* - Sud-Est-Europeo. (Griebl, 2010)
959. *Senecio doronicum* (L.) L. - Mediterraneo-Montano *
960. *Senecio scopoili* Hoppe & Hornsch. Ex Bluff & Fingerh. - Appennino-Balcanico. *
961. *Senecio ovatus* (G. Gartner & Al.) subsp. *stabianus* (Lacaita) Greuter - Europeo-Caucasico. (G. Galetti, *info. pers.*) *
962. *Senecio vulgaris* L. - Eurimediterraneo *
963. *Serratula tinctoria* L. subsp. *tinctoria* - Eurosiberiano *
964. *Silybum marianum* (L.) Gaertn. - Eurimediterraneo *
965. *Solidago virgaurea* L. subsp. *virgaurea* - Circumboreale *
966. *Sonchus asper* (L.) Hill subsp. *asper* - Eurasiatico - (Tammaro, 1986)
967. *Sonchus oleraceus* L. - Subcosmopolita *
968. *Tanacetum corymbosum* (L.) Sch. Bip. subsp. *corymbosum* - Eurimediterraneo. (Griebl, 2010)
969. *Tanacetum parthenium* (L.) Sch. Bip. - Eurimediterraneo. (Tammaro, 1986)
970. *Taraxacum apenninum* (Ten.) Ten. - Endemico *
971. *Taraxacum glaciale* E. & A. Huet. ex Hand.-Mazz. - Appennino-Balcanico. (Blasi *et al*., 2005; Di Fabrizio, 2006)
972. *Taraxacum officinale* Weber - Circumboreale *
973. *Tephroseris integrifolia* (L.) Holub - Artico-Alpino *
974. *Tragopogon porrifòlius* L. subsp. *eriospermus (*Ten) Greut.- Mediterraneo-Orientale. (Feoli Chiapella, 1979-1980)
975. *Tragopogon porrifolius* L. subsp. *porrifolius* - Eurimediterraneo *
976. *Tragopogon pratensis s. l.* L. - Eurosiberiano *
977. *Tusillago farfara* L. - Paleotemperato *
978. *Urospermum dalechampii* (L.) F. W. Schmidt - Eurimediterraneo *
979. *Xeranthemum cylindraceum* Sm. - Pontico. MFU *
980. *Xeranthemum inapertum* (L.) Mill. - Mediterraneo--Pontico *

ALISMATACEAE

981. *Alisma plantago-aquatica* L. - Subcosmopolita *

JUNCAGINACEAE

982. *Triglochin palustre* L. - Subcosmopolita *

POTAMOGETONACEAE

983. *Potamogeton berchtoldii* Fieber - Subcosmopolita *
984. *Potamogeton natans* L. - Subcosmopolita *

MELANTHIACEAE

985. *Paris quadrifolia* L. - Eurasiatico. (Griebl, 2010)
986. *Veratrum nigrum* L. Eurasiatico *

XANTHORRHOEACEAE

987. *Asphodeline lutea* (L.) Rchb. – Mediterrnaeo-Orientale. (Griebl, 2010)
988. *Asphodelus macrocarpus* Parl. subsp. *macrocarpus* - Mediterraneo-Montano. (Di Cecco, 1999)

ASPARAGACEAE

989. *Anthericum liliago* L. Subatlantico *
990. *Asparagus acutifolius* L. - Stenomediterraneo*
991. *Bellevalia romana* (L.) Sweet - Stenomediterraneo*
992. *Convallaria majalis* L. - Circumboreale. (Griebl, 2010)
993. *Loncomelos pyrenaicus (*L.) Hrouda ex J. Holub (Sin *Ornithogalum pyrenaicum*) - Eurimediterraneo. (Feoli Chiapella, 1979-80; Galetti, 2008, Griebl, 2010)
994. *Leopoldia comosa* (L.) Parl. - Eurimediterraneo. (Galetti, 1995)
995. *Muscari neglectum* Guss. ex Ten. - Eurimediterraneo. (Griebl, 2010)
996. *Ornithogalum comosum* L. - Mediterraneo-Montano. (Galetti, 2008)
997. *Ornithogalum umbellatum* L. - Eurimediterraneo *
998. *Polygonatum multiflorum* (L.) All. - Eurasiatico. (Galetti, 1995; Griebl, 2010)
999. *Polygonatum odoratum* (Mill.) Druce - Circumboreale. (Griebl, 2010)
1000. *Poligonatum verticillatum* (L.) All. - Eurasiatico. (Griebl, 2010)
1001. *Prospero autumnale* (L.) Speta subsp. *autumnale* - Eurimediterraneo *
1002. *Ruscus aculeatus* L. - Eurimediterraneo. (Tammaro, 1986)
1003. *Scilla bifolia* L. - Europeo. (Tammaro, 1986)

COLCHICACEAE

1004. *Colchicum alpinum* DC. - Mediterraneo-Montano. (Tammaro, 1986)

1005. *Colchicum lusitanum* Brot. - Mediterraneo-Montano *
1006. *Colchicum neapolitanum* (Ten.) Ten. - Mediterraneo-Occidentale *

LILIACEAE

1007. *Lilium bulbiferum* L. subsp. *croceum* (Chaix) Jan - Orofita Centro-Europeo. (Tammaro, 1986; Galetti, 1995)
1008. *Lilium martagon* L. - Eurasiatico. (Galetti, 1995; Griebl, 2010)
1009. *Streptopus amplexifolius* (L.) DC. - Circumboreale. (Galetti, 2008)

AMARYLLIDACEAE

1010. *Allium lusitanicum* Lam. - Eurasiatico. (Feoli Chiapella, 1979-1980; Di Fabrizio, 2006)
1011. *Allium oleraceum* L. - Eurasiatico. (Tammaro, 1986)
1012. *Allium paniculatum* L. Paleotemperato. (Tammaro, 1986)
1013. *Allium sphaerocephalon* L. - Paleotemperato. (Griebl, 2010)
1014. *Allium tenuiflorum.* Ten. - Stenomediterraneo. (Feoli Chiapella, 1979-1980)
1015. *Allium triquetrum* L. - Mediterraneo-Occidentale*
1016. *Allium ursinun* L. subsp. *ursinum*. - Eurasiatico. (Griebl, 2010)
1017. *Allium vineale* L. - Eurimediterraneo. (Griebl, 2010)
1018. *Galanthus nivalis* L. - Europeo-Caucasico *
1019. *Narcissus poeticus* L. - Orofita Sud-Europeo. (Galetti, 1995; Di Cecco, 1999)

DIOSCOREACEAE

1020. *Tamus communis* L. Eurimediterraneo. (Griebl, 2010)

IRIDACEAE

1021. *Crocus vernus* (L.) Hill subsp. *vernus* - Eurimediterraneo. (Galetti, 1995)
1022. *Gladiolus italicus* Mill. - Eurimediterraneo. (Griebl, 2010)
1023. *Iris germanica* L. - Origine ignota (Alloctona naturalizzata) *
1024. *Iris germanica* L. var. *fiorentina* Dikes - Origine ignota (Alloctona naturalizzata) *
1025. *Iris marsica* I. Ricci & Colas. - Endemico*
1026. *Iris pseudacorus* L. Eurasiatico. (Conti, 1987; Di Cecco, 1999)

JUNCACEAE

1027. *Juncus articulatus* L. - Circumboreale *
1028. *Juncus effusus* L. - Cosmopolita *
1029. *Juncus infllexus* L. - Paleotemperato *
1030. *Juncus trifidus* (L.) subsp. *monanthos (*Jacq.) Asch. & Graebn. - Artico-alpino *
1031. *Luzula campestris* (L.) DC. - Europeo. EPNM *
1032. *Luzula multiflora* (Ehr.) Lej. subsp. *multiflora* - Circumboreale *
1033. *Luzula spicata* (L.) DC. subsp. *italica* (Parl.) Arcang. - Endemico (Blasi *et al*., 2005; Di Fabrizio, 2006)

POACEAE

1034. *Agropyron repens* (L.) PB. - Circumboreale *
1035. *Agrostis canina* L. - Eurosiberiano *
1036. *Agrostis capillaris* L. - Circumboreale. (Tammaro, 1986)
1037. *Agrostis stolonifera* L. - Circumboreale. (Tammaro, 1986)
1038. *Alopecurus aequalis* Sobol - Eurasiatico. (Pirone, 1997)
1039. *Alopecurus geniculatus* L. - Subcosmopolita *
1040. *Alopecurus myosuroides* Huds. - Subcosmopolita *
1041. *Alopecurus pratensis* L. - Eurosiberiano *
1042. *Anisantha sterilis* (L.) Nevski (Sin. *Bromus sterilis*) - Eurimediterraneo. (Tammaro, 1986)
1043. *Anisantha tectorum* L.) Nevski (Sin. *Bromus tectorum* L. subsp. *tectorum*) – Paleotemperato*
1044. *Anthoxanthum odoratum* L. subsp. *nipponicum* (Honda) Tzelev - Eurasiatico *
1045. *Arrhenatherum elatius* (L.) P. Beauv. ex J. & C. Presl subsp. *elatius* - Paleotemperato *
1046. *Arundo donax* L. - Subcomopolita *
1047. *Avena barbata* Pott ex Link - Eurimediterraneo*
1048. *Avena fatua* L. - Eurasiatico*
1049. *Avena sterilis* L. Eurimediterraneo *
1050. *Avenula praetutiana* (Parl. ex Arcang.) Pignatti - Endemico. (Tammaro, 1986; Di Fabrizio, 2006)
1051. *Brachypodium genuense* (DC.) Roem. & Schult. - Orofita Sud-Europeo. (Di Fabrizio, 2006)
1052. *Brachypodium pinnatum* (L.) P. Beauv. - Eurasiatico *
1053. *Brachypodium retusum* (Pers.) Beauvais - Ovest-Mediterraneo. (G. Ciaschetti, *info. pers.*) *
1054. *Brachypodium rupestre* (Host) Roem. & Schult. - Subatatlantico *
1055. *Brachypodium sylvaticum* (Huds.) Beauv. - Paleotemperato. (G. Ciaschetti, *info. pers.*) *
1056. *Briza maxima* L. - Subtropicale *
1057. *Briza media* L. - Eurosiberiano *
1058. *Bromopsis erecta* (Huds.) Fourr. (Sin. *Bromus erectus* subsp. *erectus)* - Paleotemperato. (Di Cecco, 1999)

1059. *Bromopsis inermis* (Leyss.) Holub (Sin. *Bromus inermis*) - Eurasiatico. (Conti & Pellegrini, 1988)
1060. *Bromopsis ramosa* (Huds.) Holub - Eurasiatico *
1061. *Bromus arvensis* L. subsp. *arvensis* - Eurosiberiano. (Tammaro, 1986)
1062. *Bromus hordeaceus* L. subsp. *hordeaceus* - Cosmopolita *
1063. *Bromus sterilis* L. - Mediterraneo-Turaniano. (Tammaro, 1986)
1064. *Bromus tectorum* L. - Paleotemperato *
1065. *Catapodium rigidum* (L.) C. E. Hubb. Ex Dony subsp.*rigidum* - Eurimediterraneo *
1066. *Cynodon dactylon* (L.) Pers. - Cosmopolita *
1067. *Cynosurus cristatus* L. - Europeo-Caucasico *
1068. *Cynosurus echinatus* L. - Eurimediterraneo. (Tammaro, 1986)
1069. *Dactylis glomerata* L. subsp**.** *glomerata* - Paleotemperato *
1070. *Deschampsia caespitosa* (L.) Beauv. - Subcosmopolita *
1071. *Digitaria sanguinalis* (L.) Scop. - Cosmopolita *
1072. *Elythrigia repens* (L.) Nevski - Circumboreale *
1073. *Festuca alfrediana* Foggi & Signorini - Appennino-Balcanico. (Di Fabrizio, 2006)
1074. *Festuca arundinacea* Schreb. - Paleotemperato *
1075. *Festuca bosniaca* Kumm. & Sendt. subsp. *bosniaca* - Appennino-Balcanico. EPNM *
1076. *Festuca circummediterranea* Patzke - Eurimediterraneo. (Tammaro, 1986)
1077. *Festuca dimorpha* Guss. - Orofita Sud-Ovest-Europeo. (Di Cecco, 1999)
1078. *Festuca gigantea* (L.) Vill. - Eurasiatico *
1079. *Festuca heterophylla* Lam. - Europeo-Caucasico *
1080. *Festuca inops* De Not. - Endemico. (Di Fabrizio, 2006)
1081. *Festuca jeanpertii* (St. Yves) Mgf. Dgb. - Appennino-Balcanico *
1082. *Festuca laevigata* (Gaudin) subsp. *crassifolia* (Gaudin) Kerguélen & Plonka - Orofita Sud-Ovest-Europeo. (Blasi *et al*., 2005)
1083. *Festuca ovina* L. - Europeo *
1084. *Festuca pratensis* Huds. - Eurasiatico. (Tammaro, 1986)
1085. *Festuca robustifolia* Markgr. Dann. - Endemico *
1086. *Festuca rubra* L. subsp. *rubra* - Subcosmopolita. (Tammaro, 1986)
1087. *Festuca violacea* Schleich. ex Gaudin subsp. *italica* Foggi, Graz, Rossi & Signorini - Endemico. (Blasi *et al*., 2005)
1088. *Glyceria plicata* Fries - Subcosmopolita *
1089. *Helictochloa versicolor* subsp. *praetutiana* (Arcang.) Romero Zarco - Endemico. (Blasi *et al*., 2005)
1090. *Holcus lanatus* L. - Circumboreale *
1091. *Hordelymus europaeus* (L.) Harz - Europeo-Caucasico. (Tammaro, 1986)
1092. *Hordeum murinum* L. subsp. *murinum* - Circumboreale *
1093. *Koeleria spelndens* Presl - Mediterraneo-Montano *
1094. *Melica ciliata* L. subsp. *ciliata* - Eurimediterraneo. (Tammaro, 1986)
1095. *Melica uniflora* Retz. - Paleotemperato. EPNM *
1096. *Milium effusum* L. - Circumboreale *
1097. *Nardus stricta* L. - Eurosiberiano. (Tammaro, 1986; Di Fabrizio, 2006)
1098. *Ochlopoa annua* (L.) H. Scholz - Cosmopolita *
1099. *Phalaris bracjstachys* L. - Eurimediterraneo *
1100. *Phalaroides arundinacea* (L.) Rauschert - Circumboreale. (Manzi, 1992)
1101. *Phleum alpinum* L. subsp. *rhaeticum* (Humphries) Rauschert - Europeo. (Blasi *et al*., 2005; Di Fabrizio, 2006)
1102. *Phleum hirsutum* Honck. subsp. *ambiguum* (Ten.) Tzvelev - Endemico *
1103. *Phragmites australis* (Cav.) Trin. ex Steud. subsp. *australis* - Cosmopolita *
1104. *Poa annua* L. - Cosmopolita *
1105. *Poa alpina* L. subsp. *alpina* - Circumboreale. (Blasi *et al*., 2005; Di Fabrizio, 2006)
1106. *Poa badensis* Haenke ex Willd. - Mediterraneo-Montano. (Di Fabrizio, 2006)
1107. *Poa bulbosa* L. - Paleotemperato *
1108. *Poa compressa* L. - Circumboreale *
1109. *Poa molineri* Balbis. – Orofita - Sud-Est-Europeo *
1110. *Poa nemoralis* L. - Circumboreale *
1111. *Poa palustris* L. - Circumboreale. (Tammaro, 1986)
1112. *Poa pratensis* L. - Circumboreale. (Tammaro, 1986)
1113. *Poa trivialis* L. subsp. *trivialis* - Eurasiatico *
1114. *Sesleria juncifolia* Suffren subsp. *juncifolia* - Appennino-Balcanico. (Di Fabrizio, 2006)
1115. *Sesleria nitida* Ten. - Endemico. (Di Fabrizio, 2006)
1116. *Setaria viridis* (L.) P. Beauv. subsp. viridis - Cosmopolita *
1117. *Stipa dasyvaginata* Martinovsky subsp. *apenninicola* Martinovsky & Moraldo - Endemico *
1118. *Tragus racemosus* (L.) All. Subcosmopolita *
1119. *Trisetaria flavescens* (L.) Baumg. - Eurasiatico *
1120. *Trisetaria villosa (*Bertol.) Banfi & Soldano - Endemico *

ARACEAE

1121. *Arum italicum M*Ill. subsp. italicum - Stenomediterraneo *
1122. *Arum maculatum* L. - Europeo *

TYPHACEAE

1123. *Sparganium erectum* (L.) subsp. *erectum* - Eurasiatico *
1124. *Typha latifolia* L. - Cosmopolita *

CYPERACEAE

1125. *Carex acuta* L. - Eurasiatico. (Conti *et al*., 1990)
1126. *Carex buxbaumii* Wahlenb. - Circumboreale. (Conti *et al*., 1990)
1127. *Carex canescens* L. - Cosmopolita *
1128. *Carex capillaris* L. - Artico-Alpino *
1129. *Carex caryophyllea* Latourr. - Eurasiatico *
1130. *Carex distans* L. Eurimediterraneo *
1131. *Carex disticha* Huds. Eurosiberiano. (Conti *et al*., 1990)
1132. *Carex divisa* Huds. - Mediterraneo-Atlantico. EPNM *
1133. *Carex elata* All. subsp. *elata* - Europeo-Caucasico. EPNM *
1134. *Carex flacca* Schreb. subsp. *flacca* - Europeo *
1135. *Carex hirta* L. - Europeo-Caucasico *
1136. *Carex humilis* Leyss. - Eurasiatico. (Blasi *et al*., 2005; Di Fabrizio, 2006)
1137. *Carex kitaibeliana* Degen ex Beck. subsp. *kitaibeliana* - Appennino-Balcanico. (Blasi *et al*., 2005; Di Fabrizio, 2006)
1138. *Carex macrolepis* DC. - Appennino-Balcanico. (Di Fabrizio, 2006)
1139. *Carex otrubae* Podp. - Mediterraneo- Atlantico. EPNM & MFU *
1140. *Carex paniculata* L. - Europeo-Caucasico *
1141. *Carex pendula* Huds. - Eurasiatico *
1142. *Carex sylvatica* Huds. Eurasiatico. (Tammaro, 1986)
1143. *Carex tomentosa* L. - Eurosiberiano. (Conti *et al*., 1990)
1144. *Carex vesicaria* L. - Circumboreale *
1145. *Eleocharis palustris* (L.) R. & S. - Subcosmopolita *

ORCHIDACEAE

1146. *Anacamptis laxiflora (*Lam.) R. M. Bateman, Pridgeon & M. W. Chase - Eurimediterraneo. (Conti, 1998)
1147. *Anacamptis morio* (L.) R. M. Bateman, Pridgeon & M. W. Chase - Europeo-Caucasico. (Griebl, 2010; Di Cecco & Pezzetta, 2012)
1148. *Anacamptis pyramidalis* (L.) Rich. - Eurimediterraneo. (Di Cecco & Pezzetta, 2012)
1149. *Cephalanthera damasonium (*Mill.) Druce - Eurimediterraneo. (Di Cecco & Pezzetta, 2012)
1150. *Cephalanthera longifolia* (L.) Fritsch - Eurasiatico. (Galetti, 1995)
1151. *Cephalanthera rubra* (L.) Rich. - Eurasiatico (Galetti, 1995)
1152. *Coeloglossum viride* (L.) Hartm. - Circumboreale. (Di Cecco & Pezzetta, 2012)
1153. *Dactylhoriza incarnata* subsp. *incarnata* (L.) Soó - Eurosiberiano. (Daiss & Daiss, 1996)
1154. *Dactylorhiza maculata* subsp. *maculata* (L.) Soó - Paleotemperato. (Daiss & Daiss, 1996)
1155. *Dactylorhiza maculata* subsp. *saccifera* (Brongn.) Diklić - Paleotemperato. (Tammaro, 1982; Galetti, 1995)
1156. *Dactylorhiza sambucina* (L.) Soó - Europeo. Galetti, 1995)
1157. *Epipactis atrorubens* (Hoffm.) Besser - Europeo. (Di Cecco & Pezzetta, 2012)
1158. *Epipactis helleborine* subsp. *helleborine* (L.) Crantz - Paleotemperato. (Galetti, 1995)
1159. *Epipactis helleborine* subsp. *latina* W. Rossi & E. Klein - Subendemico (Daiss & Daiss, 1996)
1160. *Epipactis microphylla (Ehrh.*) Sw. - Europeo-Caucasico (Griebl, 2010)
1161. *Epipactis mulleri* Godfery - Centroeuropeo. (Conti & Pellegrini, 1990)
1162. *Epipactis persica* subsp. *gracilis* (B. Baumann & H. Baumann) W. Rossi - Sud-Est-Europeo . (Conti & Pellegrini, 1990)
1163. *Epipactis purpurata* Sm. - Subatlantico. (N. Centurione & M. Pellegrini, *info. pers*.)
1164. *Epipogium aphyllum* Sw. - Eurosiberiano. (Conti & Pellegrini, 1990)
1165. *Himantoglossum adriaticum* H. Baumann - Eurimediterraneo. (Di Cecco & Pezzetta, 2012)
1166. *Limodorum abortivum* (L.) Sw. - Eurimediterraneo (Daiss & Daiss, 1996)
1167. *Listera ovata* (L.) R. Br. - Eurasiatico. (Di Cecco & Pezzetta, 2012)
1168. *Neotinea maculata* (Desf.) Stearn - Mediterraneo-Atlantico. (Daiss & Daiss, 1996)
1169. *Neotinea tridentata* (Scop.) R. M. Bateman, Pridgeon & M. W. Chase - Eurimediterraneo. Di Cecco & Pezzetta (2012)
1170. *Neotinea ustulata* (L.) R. M. Bateman, Pridgeon & M. W. Chase - Europeo-Caucasico. (Di Cecco & Pezzetta, 2012)
1171. *Neottia nidus avis* (L.) Rich. - Eurasiatico. (Di Cecco & Pezzetta, 2012)
1172. *Ophrys apifera* Huds. - Eurimediterraneo. (Di Cecco & Pezzetta, 2012)
1173. *Ophrys bertolonii* Mor. - Appennino-Balcanico. (Di Cecco & Pezzetta, 2012)
1174. *Ophrys dinarica* R. Kranjcev & P. Delforge - Appennino-Balcanico. (Hertel & Presser, 2009)
1175. *Ophrys illyrica* S. & K. Hertel - Appennino-Balcanico *
1176. *Ophrys fusca* subsp. *fusca* Link - Mediterraneo-Atlantico. (Di Cecco & Pezzetta, 2012)
1177. *Ophrys fusca* subsp. *lucana* (P. Delforge, Devillers-Tersch. & Devillers) Kreutz - Endemico. (Di Cecco & Pezzetta, 2012)
1178. *Ophrys holosericea* subsp. *apulica* (O. Danesch & E. Danesch) Buttler - Endemico. (Conti & Pellegrini, 1990)
1179. *Ophrys holosericea* (Burm f.) Greuter subsp. *holosericea* - Eurimediterraneo. (Conti & Pellegrini,

1990). Secondo Souche (*comm. pers.*) in Italia la specie è assente.

1180. *Ophrys holosericea* subsp. *tetraloniae* (W. P. Teschner) Kreutz - Appennino-Balcanico (Conti, 1998)
1181. *Ophrys incubacea Bi*anca - Stenomediterraneo. (Di Cecco & Pezzetta, 2012)
1182. *Ophrys insectifera* L. -Europeo. (Conti & Pellegrini, 1990)
1183. *Ophrys lutea* subsp. *lutea* Cav. - Stenomediterraneo. (Conti & Pellegrini, 1990). Secondo Griebl (2010) la presenza di *Ophrys lutea* in Abruzzo è dubbia e gli esemplari sono da attribuire a *Ophrys sicula*.
1184. *Ophrys pinguis* Romolini & Soca - Endemico. (Romolini & Soca, 2011)
1185. *Ophrys promontorii* O. & E. Danesch - Endemico. (Conti, 1998)
1186. *Ophrys scolopax* Cav. - Eurimediterraneo. (Conti & Pellegrini, 1990)
1187. *Ophrys sphegodes* subsp. *majellensis* Helga & Herm. Daiss - Endemico (Daiss & Daiss, 1996)
1188. *Ophrys sphegodes* subsp. *sphegodes* Mill. - Eurimediterraneo. (Conti & Pellegrini, 1990)
1189. *Ophrys sphegodes* subsp. *tommasinii* (Vis.) Soó - Appennino-Balcanico. (Hertel & Hertel, 2006)
1190. *Orchis anthropophora* (L.) All. - Mediterraneo-Atlantico. (Di Cecco & Pezzetta, 2012)
1191. *Orchis italica Poir.* - Stenomediterraneo. (Daiss & Daiss, 1996)
1192. *Orchis mascula* subsp. *speciosa* (Mutel) Hegi - Centroeuropeo. (Griebl, 2010).
1193. *Orchis militaris* L. - Eurasiatico. (Di Cecco & Pezzetta, 2012)
1194. *Orchis pauciflora* Ten. - Stenomediterraneo.(Di Cecco & Pezzetta, 2012)
1195. *Orchis purpurea* Huds. - Eurasiatico.(Di Cecco & Pezzetta, 2012)
1196. *Orchis simia* Lam. - Eurimediterraneo. (Daiss & Daiss, 1996)
1197. *Platantherera bifolia* (L.) Rchb. - Paleotemperato. (Daiss & Daiss, 1996)
1198. *Platanthera chlorantha* (Custer) Rchb. - Eurosiberiano. (Tammaro, 1986; Galetti, 1995)
1199. *Serapias cordigera* L. - Stenomediterraneo. (Daiss & Daiss, 1996)
1200. *Serapias parviflora* Parl. - Stenomediterraneo. (Conti & Pellegrini, 1990)
1201. *Serapias vomeracea* (Burm) Brig. - Eurimediterraneo. (Daiss & Daiss, 1996)

Note:
EPNM = Erbario Parco Nazionale della Majella
MFU = Museo Friulano di Scienze naturali, Udine
* Specie nuova per Palena

DISCUSSIONE

L'elenco floristico sopra riportato è costituito da 1201 taxa di cui 619 nuovi per l'ambito in esame.

La prima considerazione da fare è che un'area che rappresenta solo lo 0,03 % dell'intero territorio italiano ospita oltre il 15 % della sua flora costituita nel 2010 da 7953 taxa (Peruzzi 2010), a evidente dimostrazione dell'elevata biodiversità locale. Inoltre la flora palenese costituisce circa il 57 % della flora dell'intero Comprensorio del Parco Nazionale della Majella, che ammonta a 2118 taxa (Conti & Tinti, 2006) e circa il 35 % della flora regionale dell'Abruzzo che al termine del 2010 annoverava 3409 diverse entità (Peruzzi, 2010). Tale alto valore floristico è da attribuire al moderato distrurbo antropico, alla varietà del paesaggio vegetale e dei litotipi locali e all'elevata escursione altitdunale che a sua volta accentua le eterogeneità climatiche e ambientali.

Nell'inventario floristico sono riportati 22 taxa inclusi nella liste rosse (Conti *et al*., 1997) o protetti dalle leggi regionali abuzzesi tra cui: *Anemone apennina* subsp. *apennina*, *Artemisia umbelliformis* subsp. *eriantha, Atropa belladonna, Daphne mezereum, Gentiana dinarica, Gentiana lutea* subsp. *lutea, Iris marsica, Leontopodium nivale, Lilium bulbiferum* subsp. *croceum, Lilium martagon, Pinus mugo* subsp. *mugo, Primula auricula* subsp. *ciliata, Primula veris* subsp. *suaveolens, Ranunculus lateriflorus, Taxus baccata, Trollius europaeus* subsp. *europaeus* e *Viola magellensis.*

Altre specie di particolare pregio che contribuiscono ad arricchire il valore naturalistico sono le seguenti:

- *Acer cappadocium* subsp. *lobelii* che in questa zona raggiunge il limite settentrionale del suo areale di distribuzione geografica;
- *Malcolmia orsiniana* subsp. *orsiniana,* entità Appennino-Balcanica inclusa nella lista rossa nazionale e che in Italia è segnalata solo in Abruzzo e Marche;
- *Papaver alpinum* subsp. *ernesti mayeri*, entità subendemica segnalata in Slovenia, Friuli Venezia Giulia ed Abruzzo ove raggiunge il limite meridionale di distribuzione geografica. E' protetta dalle leggi regionali;
- *Hieracium bifidum* subsp. *nummulariifolium, Hieracium hypochoeroides* subsp. *potamogetifolium, Hieracium murorum* subsp. *subintegerrimum, Hieracium orodoxum, Hieracium montis-porrarae, Hieracium pseudopallidum* e *Hieracium racemosum* subsp. *pulmonarifolium,* elementi stenoendemici recentemente descritti ed esclusivi o del M. Porrara, della Tavola Rotonda o dell'Abruzzo;
- *Lathyrus pannonicus* subsp. *asphodeloides*, una Fagaceae che in Italia è segnalata solo nel Lazio, Abruzzo e Molise;
- *Carex disitcha* e *Carex buxbaumii*, due Cyperaceae incluse nella lista rossa nazionale, molto rare per la flora italiana e che nell'ambito in esame raggiungono il limite meridionale di distribuzione geografica;

- *Ophrys majellensis* (Fig. 4) e *Ophrys pinguis*, due Orchidaceae endemiche di cui il territorio di Palena costituisce il *locus classicus* insieme ad altri più o meno vicini;
- *Ranunculus marsicus*, elemento endemico dell'Abruzzo;
- *Triglochin palustre,* una Juncaginaceae che in Abruzzo raggiunge il limite meridionale di distribuzione geografica.

Le famiglie ammontano a 88 e di queste più rappresentate sono le Asteraceae con 157 taxa, le Poaceae con 87, le Fabaceae con 85, le Lamiaceae con 61, le Brassicaceae con 59, le Orchidaceae con 56, le Rosaceae con 55, le Cariophyillaceae con 53, le Ranunculaceae con 48, le Apiaceae con 43, le Plantaginaceae con 33, le Boraginaceae, le Caprifoliaceae e le Cyperaceae con 21, le Orobanchaceae e le Rubiaceae con 20. Seguono le altre con valori minori.

Tra le varie famiglie assumono una grande importanza le Orchidaceae in quanto rare, di estrema bellezza ed indicatrici di un elevata qualità dell'ambiente. Nell'elenco floristico sono riportate 56 entità, un numero apparentemente non rilevante, ma che in realtà costituisce il 66 % del patrimonio orchidologico abruzzese e

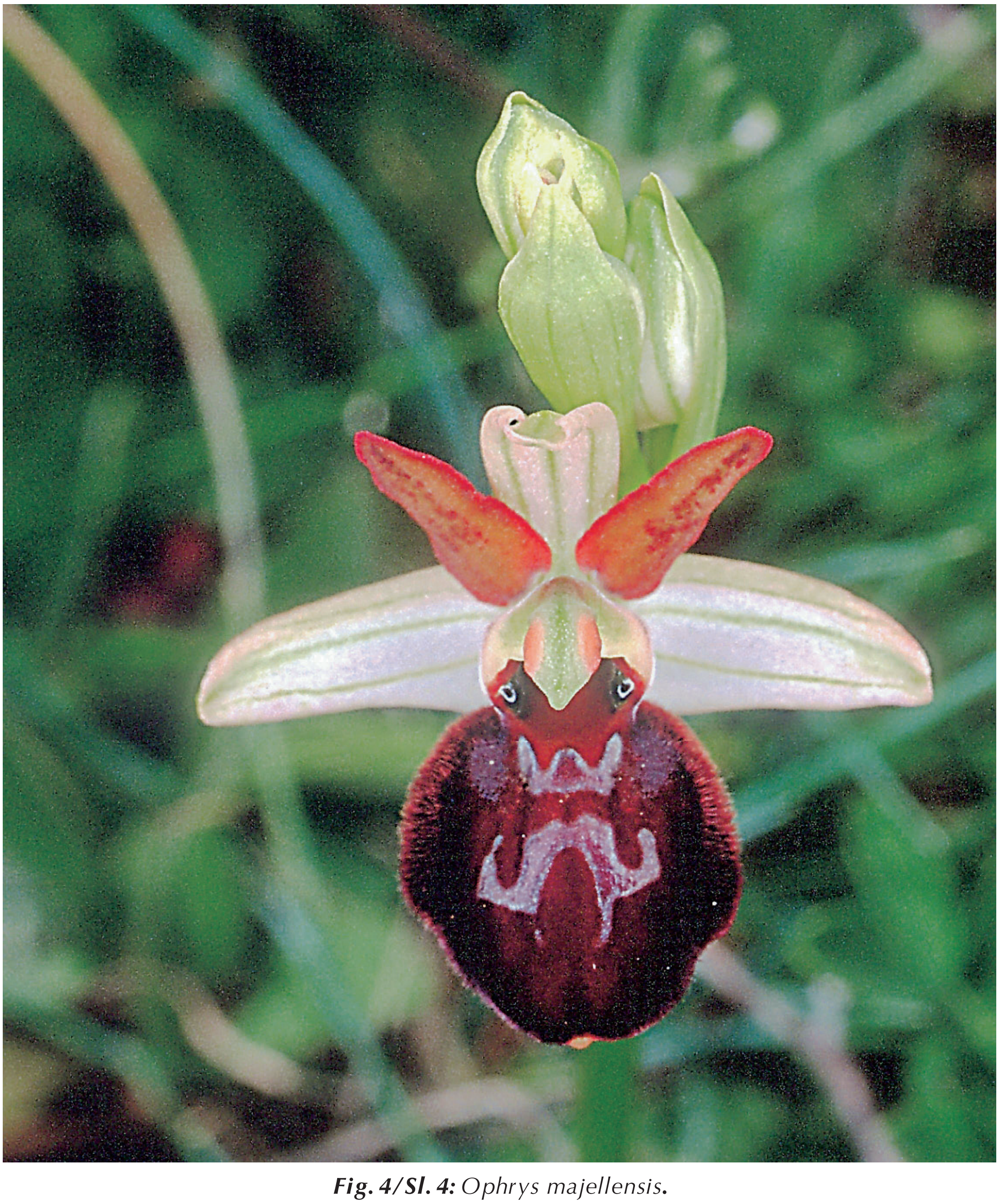

***Fig. 4/Sl. 4:** Ophrys majellensis**.*

circa il 28 % di quello nazionale (Di Cecco & Pezzetta, 2012). Anche i generi *Hieracium* e *Pilosella* comprendenti nel complesso 22 taxa sono indicatori di buona qualità dell'ambiente locale poichè tipici di ambiti intatti ed incontaminati.

Tab. 1: Spettro biologico della flora di Palena.
Tab. 1: Biološki spekter flore občine Palena.

Tipo biologico	Valori assoluti	%
Emicriptofita	588	48,96
Geofita	169	14,07
Fanerofita	101	8,41
Camefita	121	10,07
Terofita	195	16,24
Nanofanerofita	21	1,75
Idrofita	6	0,50
Totale	**1201**	**100,00**

Nella Tabella 1 è riportato lo spettro biologico della flora di Palena. Esso documenta che le emicriptofite sono presenti in maggior numero. Esse sono tipiche di ambienti temperati e aperti e sono presenti in tutte le fasce altimetriche. Seguono le terofite diffuse soprattutto alle quote più basse. A loro volta documentano gli influssi mediterranei e quindi la presenza di ambiti termofili. Anche le geofite sono rappresentate da valori abbastanza alti e leggermente inferiori a quelli delle terofite. La loro presenza è legata all'esistenza di ambiti boschivi, di zone umide e di prato-pascoli oligotrofici che non sono sottoposti a concimazione e quindi sono caratterizzati da un alto grado di naturalità. Le camefite a loro volta sono entità vegetali tipiche di ambiti rocciosi, glareicoli e di suoli primitivi quali quelli dei prati aridi più o meno sassosi. Seguono le fanerofite e la loro percentuale rilevante documenta la ricchezza in specie arboree dei boschi locali. Le poche idrofite rilevate sono state osservate lungo il torrente Vera all'altipiano di Quarto S. Chiara.

Nella Tabella 2 sono riportati i corotipi con i taxa assegnati ad ognuno di essi. La tabella di cui sopra documenta che la flora di Palena è costituita da entità appartenenti a oltre 40 corotipi diversi e quindi di diversa origine e distribuzione geografica che da un lato confermano che l'area, come il resto del massiccio della Majella e dell'Abruzzo, rappresenta un crocevia di flussi floristici e dall'altro che le diverse condizioni climatiche ed ambientali causate dal'ampia escursione altitudinale consentono l'adattamento di piante con diverse esigenze termiche ed ecologiche.

Raggruppando i vari corotipi in base ad una comune distribuzione geografica ad esempio tutti quelli mediterranei, europei, eurasiatici, etc. si ottiene che ognuno di essi è assume la seguente consistenza numerica:

- L'elemento mediterraneo, comprendente i corotipi eurimediterraneo, est-mediterraneo, stenomediterraneo, comprende 326 taxa corrispondenti al 27,14 % del corteggio floristico.
- L'elemento eurasiatico, a sua volta comprendente i coropiti eurasiatico s.s., eurosiberiano, pontico, paleotemperato ed europeo-caucasico è costituito da 350 taxa corrispondenti al 29,14 %.
- L'elemento europeo comprendente i corotipi appennino-balcanico, europeo s.s., sud-europeo, sud-ovest-europeo. centro-europeo, europeo-occidentale, orofita sud–est-europeo etc, è costituito da 241 taxa, corrispondenti a oltre il 20 % della flora.
- L'elemento nordico comprendente i corotipi artico-alpino e circumboreale è costituito da 84 taxa, corrispondenti a circa il 7 % della flora.
- L'elemento a larga distribuzione geografica costituito dai corotipi cosmopolita e subcosmopolita comprende 60 taxa corrispondenti a circa il 5 % della flora.
- L'elemento alloctono costituito dai corotipi asiatico s.l., nord-americano, tropicale s.l. comprende 15 taxa, corrispondenti al 1,25 % della flora; le restanti specie afferenti a tale categoria sono di origine (corotipo) ignota. La bassa percentuale di tale componente è un ulteriore fattore che dimostra l'alto grado di naturalità del territorio in esame e la bassissima contaminazione floristica ivi esistente.
- L'elemento atlantico costituito dai corotipi subatlantico e mediterraneo-atlantico comprende 21 taxa corrispondenti al 1,75 % della flora.
- L'elemento endemico, comprendente i corotipi endemico e subendemico, è costituito da 104 taxa, corrispondenti al 8,66 % della flora ed è rappresentato da un valore percentuale superiore a quello nazionale, a ulteriore conferma dell'importanza naturalistica del territorio palenese.

Tali dati dimostrano che l'elemento eurasiatico è predominante ed è seguito dall'elemento mediterraneo che a sua volta costituisce il più diffuso nella flora di territori vicini. In base a tali fatti si può osservare che nel territorio in esame si registra una transizione floristica e fitogeografica.

Seguendo la proposta di Poldini (1991) è stato fatto un secondo raggruppamento di corotipi in base alle esigenze termiche dei vari taxa che ha portato ai seguenti risultati.

Il gruppo dei corotipi microtermici (artico-alpino, circumboreale, mediterraneo-montano, orofita sud-europeo, orofita sud-est-europeo, orofita sud-ovest-europeo ed orofita centro-europeo), costituito da piante capaci di sopravvivere in ambiti con basse temperature è costituito da 231 taxa corrispondenti al 19,2 % della flora. Il gruppo dei corotipi mesotermici, (centro-europeo, cosmopolita, eurasiatico, europeo, ovest-europeo, europeo-caucasico, eurosiberiano, mediterraneo-atlantico, paleotemperato e subcosmopolita) costituito da piante tipiche degli ambienti temperati freschi è costi-

Tab. 2: Corotipi della flora di Palena.
Tab. 2: Korotipi flore občine Palena.

Elementi geografici	Numero taxa	%
Endemico e Subendemico	**104**	**8,67**
Mediterraneo	**326**	**27,14**
Eurimediterraneo	186	
Mediterraneo-Montano	81	
Stenomediterraneo	44	
Nord-Mediterraneo	3	
Est-Mediterraneo	4	
Nord-Est-Mediterraneo	1	
Ovest-Mediterraneo	7	
Mediterraneo-Pontico	3	
Mediterraneo-Turaniano	5	
Eurasiatico	**350**	**29,14**
Eurasiatico s.s.	127	
Europeo-Caucasico	52	
Eurosiberiano	54	
Pontico	36	
Paleotemperato	81	
Nordico	**84**	**6,99**
Artico-Alpino	19	
Circumboreale	65	
Europeo	**241**	**20,07**
Europeo s.s.	61	
Centro-Europeo	12	
Orofita Centro-Europeo	2	
Orofita Sud-Europeo	34	
Orofita Sud-Est-Europeo	20	
Orofita Sud-Ovest-Europeo	9	
Sud-Europeo	5	
Sud-Est-Europeo	23	
Sud-Ovest-Europeo	4	
Ovest-Europeo	3	
Appennino-Balcanico	71	
Mediterraneo-Atlantico e Subatlantico	**21**	**1,75**
Cosmopolita	**60**	**5,00**
Cosmopolita s.s.	33	
Subcosmopolita	27	
Asiatico s.l.	**4**	**0,33**
Nordamericano	**1**	**0,08**
Tropicale	**3**	**0,25**
Greco	**1**	**0,08**
Origine ignota	**6**	**0,50**
TOTALE	**1201**	**100**

tuito da 472 taxa (39, 3 % della flora). Il gruppo dei corotipi macrotermici, costituito da piante tipiche di ambienti caldo-temperati (est-mediterraneo, eurimediterraneo, mediterraneo-occidentale, mediterraneo-pontico, mediterraneo-turaniano, paleotropicale, pontico, subtropicale, sud-europeo, sud-est-europeo, sud-ovest-europeo e stenomediterraneo) è costituito da 321 taxa corrispondenti al 26,7 % della flora. Il restante 14,8 % dei taxa non è stato considerato.

I dati riportati dimostrano che prevalgono i taxa dei corotipi temperati e di conseguenza le osservazioni ai dati della tabella 2 si accordano con quelle sulla Tabella 1.

Al fine di evidenziare da quali quadranti sono giunti i maggiori apporti floristici, i diversi corotipi sono stati raggruppati in: occidentali, orientali, nordici e meridionali. I risultati ottenuti sono stati i seguenti:

- 44 taxa corrispondenti ai corotipi ovest-mediterraneo, subatlantico, mediterraneo-atlantico, ovest e sud-ovest-europeo s.l. sono considerati di origine occidentale e sud-occidentale;
- 84 taxa corrispondenti ai corotipi artico-alpino e circumboreale sono di origine nordica;
- 468 taxa corrispondenti ai corotipi eurasiatico s.l. appennino-balcanico, mediterraneo-pontico, mediterraneo.turaniano e sud-est-europeo s.l. sono considerati di origini orientali e sud-orientali;
- 359 taxa corrispondenti ai corotipi sud-europeo s.l., est-mediterraneo, sud-est-mediterraneo, stenomediterraneo, eurimediterraneo, nord-mediterraneo e mediterraneo-montano sono da considerare di origini meridionali.

Tali dati dimostrano che i principali flussi floristici migratori che hanno interessato il territorio in esame sono di origini sud-orientali attingendo al bacino mediterraneo e al continente eurasiatico.

RINGRAZIAMENTI

Per aver consentito l'acesso ai dati d'erbario conservati presso il Museo Friulano di Storia Naturale, si ringraziano il Dott. Martini Fabrizio ed il Dott. Buccheri Massimo. Per aver consentito l'acesso ai dati d'erbario conservati presso l'Ente Parco Nazionale della Majella siringraziano il Dott. Cimini Nicola e il Dott. Ciaschetti Giampiero. Per l'assistenza tecnica si ringrazia Galetti Giovanni, Raiser Paolo e Vigini Bruno.

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POVZETEK

Palena je majhna občina v deželi Abruci, pokrajini Chieti, katere ozemlje se nahaja v Narodnem parku Majella. V članku avtorji podajajo floristični seznam tega ozemlja, ki vsebuje 1201 takson. Ugotavljajo, da na deležu ozemlja, ki predstavlja le 0,03 % celotnega italijanskega ozemlja, domuje 15 % italijanske flore. Najbolj zastopani floristični kontingenti so: evrazijski s 350 taksoni, mediteranski s 326 taksoni in evropski z 241 taksoni. Med temi je 619 novih taksonov in 104 endemičnih in pod-endemičnih taksonov. Nekatere pomembne vrste, ki se nahajajo na tem ozemlju, so: Acer cappadocium *subsp.* lobelii, Malcolmia orsiniana, Papaver alpinum *subsp.* ernesti mayeri, Hieracium bifidum *subsp.* nummulariifolium, Hieracium hypochoeroides *subsp.* potamogetifolium, Hieracium bifidum *subsp.* nummulariifolium, Hieracium hypochoeroides *subsp.* potamogetifolium, Lathyrus pannonicus *subsp.* asphodeloides, Carex disitcha *in* Ophrys majellensis.

Ključne besede: flora, Palena, Chieti (Abruci)

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ON THE OCCURRENCE OF *CHARAXES JASIUS* (LEPIDOPTERA: NYMPHALIDAE) IN ISTRIA, CROATIA

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ABSTRACT

The two-tailed Pasha, Charaxes jasius*, is one of the largest and most impressive butterfly species in Europe. In Croatia it inhabits the Mediterranean coastal areas, from Rijeka south towards Dalmatia, and many Adriatic islands. Until now, its occurrence in the most northwesterly part of the Croatian shore, the Istrian peninsula, remained questionable. Three new records, from Palud, Premantura and Kalavojna, confirm its presence on the peninsula and expand its known range in Croatia. There are no suitable larval habitats north of the Mirna valley, and therefore the valley likely represents the northern distribution border for this species in Croatia. A map representing all published records from Croatia is provided.*

Key words: *Charaxes jasius, Arbutus unedo*, Istra, distribution

PRESENZA DI *CHARAXES JASIUS* (LEPIDOPTERA: NYMPHALIDAE) IN ISTRIA, CROAZIA

SINTESI

La Ninfa del corbezzolo, Charaxes jasius*, è una delle farfalle più belle ed impressionanti in Europa. In Croazia la specie vive nelle aree costiere del Mediterraneo, da Fiume verso la Dalmazia, e su molte isole adriatiche. Fino ad oggi la sua presenza nelle aree più a nord-ovest della costa croata, ossia nella penisola istriana, era incerta. Tre nuove segnalazioni provenienti da Palù (Palud), Promontore (Premantura) e Calavogna (Kalavojna) confermano la sua presenza nella penisola ed espandono la conoscenza dell'area di distribuzione della specie in Croazia. A nord della valle del fiume Quieto (Mirna) non ci sono più habitat adatti alle larve. Gli autori ipotizzano quindi che la valle rappresenti il confine più settentrionale della distribuzione della specie in Croazia. Nell'articolo è riportata anche la mappatura di tutte le segnalazioni della specie in territorio croato.*

Parole chiave: *Charaxes jasius, Arbutus unedo*, Istria, distribuzione

INTRODUCTION

The Istrian peninsula, with a surface area of 348 square kilometers, is the largest and northern-most peninsula in the Adriatic Sea. It is now divided among three countries: Croatia, Slovenia and Italy (Mihelj, 2006). The largest part lies in the territory of Croatia, and is dealt with in this paper. By geologic and geomorphic structure the peninsula can be divided in three distinct regions; White Istria, Grey Istria and Red Istria. White Istria includes the north/northeastern part of the peninsula (http://www.istrapedia.hr). It is a typical karstic area with scarce Mediterranean vegetation and karstic surfaces. Grey Istria, which stretches across the central part of the peninsula, got its name from its composition of flysch, consisting of impermeable marl, sandstone and clay. The western shore of the peninsula, Red Istria, contains limestone traces covered with red earth. About a third of the peninsula is covered with woods. Along the coast and on the islands, pinewoods, maquis and garrigue are the main vegetation types, interspersed with holm oak (*Quercus ilex*) and strawberry trees (*Arbutus unedo*) (http://www.istrapedia.hr).

Butterflies inhabiting the Croatian part of Istria have never been systematically surveyed, and only limited data exist. The best-surveyed areas are probably Učka (Rebel, 1910, 1912a, 1913a), Pazin and Vela Traba (Koren & Ladavac, 2010), Rovinj (Daniel, 1971) and Brioni (Rebel, 1912b, 1913b). For other areas, only a limited number of records exists (Stauder, 1922; Whirington, 1984). With only a modest body of published research, it is likely that various butterfly species will be newly recorded on the peninsula.

The two-tailed Pasha, *Charaxes jasius* (Linnaeus, 1767), is one of the largest and most colorful members of Nymphalidae family in Europe. This charismatic species flies in two broads, from April until October (Tolman & Lewington, 2008). Its habitat consists mostly of mixed scrubland, mostly maquis, which contains its larva host plant, *A. unedo*. The adults are attracted to fermenting fruit, so they can also be easily found around fig or apple trees. The species is distributed mainly in the coastal Mediterranean region, which includes Morocco, Algeria, Tunisia, Portugal, Spain, France and Italy, and separately, from Dalmatia to Greece and Turkey (Tolman & Lewington, 2008).

The aim of this paper is to presents first records of this species in Istria, as well as to give an overview of the distribution of the two-tailed Pasha in Croatia.

MATERIALS AND METHODS

The distribution of the species in Croatia was derived from available literature, of which 32 publications contain data on the presence of this species in Croatia (Germar, 1814–1817; Mann, 1869; Werner, 1895; Galvagni, 1902, 1909, 1921, 1935; Abafy-Aigner, 1910; Stauder, 1913, 1922; Puschnig, 1914/1915; Muller, 1921; Schawerda, 1921, 1927; Hafner, 1930; Neustetter, 1956; Moucha, 1965; Habeler, 1976, 2008; Withrington, 1984; Waring & Thomas, 1989; Reinhardt, 1990; Jakšić, 1993; Luy, 1994, 2002; Krištović, 2007; Saga, 2007; Boljat & Šuljić, 2008; Withrington & Verovnik, 2008; Lorković, 2009; Kučinić *et al*., 2011; Verovnik, 2011). Additionally, surveys of this species across the Istrian peninsula were conducted between 2008 and 2012, during several general surveys of butterfly fauna.

C. jasius was observed in these localities:

1. Palud, 1 km SE, forest edge and maquis, near the sea, 45.020577 N, 13.715416 E, 14.7.2008, 1M & 1F.
2. Pula, Premantura, Istria, edge of maquis, 44.801692 N, 13.919322 E, 15.7.2009, 1M.
3. Kalavojna, 2 km S of Rakalj, Istria, bushy area, near the forest edge, 44.963310 N, 14.053678 E, 19.7.2009, 2M.

RESULTS AND DISCUSSION

C. jasius was first noted in Croatia by Germar (1814–1817), who recorded its presence on two islands, Brač and Hvar. Subsequently, it has been recorded on many islands (*e.g.* Withrington & Verovnik, 2008; Kučinić *et al*., 2011; Verovnik, 2011) as well as across large parts of the Croatian coast, including the Kvarner region and Dalmatia (*e.g.* Stauder, 1922; Habeler, 1976).

As this species is highly dependent on its larva host plant, *A. unedo*, the plant's distribution in Croatia, according to Nikolić (2012), is also presented on the *C. jasius* distribution map. The plant's distribution in Istria fits entirely within the known range of *C. jasius* on the peninsula. In other parts of the *C. jasius* range, however, the distributions do not appear as closely matched. This discrepancy may be explained either by insufficient floristic surveys in such areas or by the high migratory potential of *C. jasius*. In the Kvarner Islands (*e.g.* Lošinj, Rab) and southern Dalmatia, the species is very common and numerous, especially in locations where the maquis contain *A. unedo*. The recorded sightings of *C. jasius* generally become sparser moving south to north. The exception is the southern-most part of Dalmatia, from Dubrovnik to the border with Montenegro, generally known as Konavle region. In 2012, a butterfly survey was carried out in the area (T. Koren, *unpubl*.), but no specimens were observed. If it is present in the area, therefore, it is probably rare and localised.

During surveys over the last five years, *C. jasius* was recorded in Istria in three localities; all of them in the coastal southwestern area of the peninsula (Fig. 1). The provisional distribution maps of butterflies in Yugoslavia (Jakšić, 1988) indicate a record for the species in Istria, near the Raša River valley, but the source of this record remains unknown. Moreover, in recent literature on the butterflies of Istria (Danijel, 1971; Kučinić *et al*., 1999; Šašić

& Mihoci, 2007, Koren & Ladavac, 2010), the species is not mentioned in this area. The Raša River valley was visited by the author on several occasions during the last five years, but no specimens were observed. It is, however, possible that this species was or still is present near the sea, around the village Trget, as the habitat is

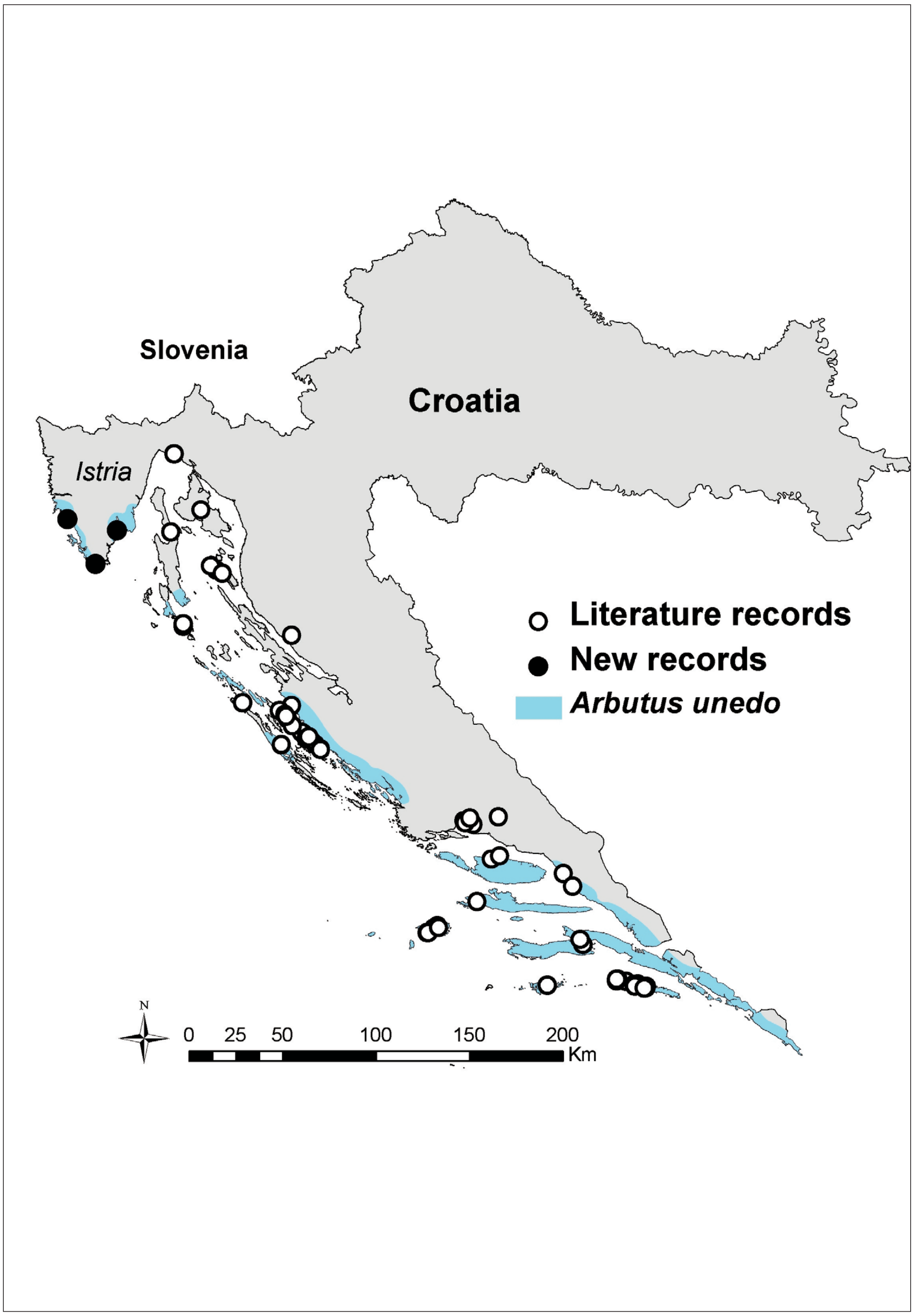

***Fig. 1: The distribution of the two-tailed Pasha** (Charaxes jasius) **in Croatia with marked presence of its larva host plant,** Arbutus unedo.*

***Sl. 1: Distribucija dvorepega paše** (Charaxes jasius) **na Hrvaškem ter zabeležena prisotnost hranilne rastline gosenic,** Arbutus unedo.*

very similar to that in Kalavojna, and *A. unedo* is also present. The sites closest to the Raša River valley where *C. jasius* has been reported are Rijeka (Stauder, 1922) and the Kvarner Islands (Withrington & Verovnik, 2008). The older records for Cres, Lošinj and Rab have been confirmed by recent surveys, with the species found to be very common in some locations (T. Koren, *unpubl.*). The presence of the species in Rijeka has never been confirmed.

The new records from Istria represent the northern-most areas for the species on the Adriatic coast, but surprisingly, there is a literature citation for the species in coastal Slovenia (Lelo, 2007). However, as there is no indication for this distribution in the recent butterfly atlas (Verovnik *et al.*, 2012), this record could be considered to be erroneous. As this species is not present in Slovenia, and it has not been recorded north of the Mirna River valley, even in intensive surveys (T. Koren, *unpubl.*), the valley itself could represent the distribution border for this species. And while the distribution of *C. jasius* in Croatia is relatively well known, not much is known about its biology, life history or conservation status – further researches should be directed towards these areas.

POJAVLJANJE DVOREPEGA PAŠE (*CHARAXES JASIUS*) V ISTRI, HRVAŠKA

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POVZETEK

Dvorepi paša (Charaxes jasius) *je eden največjih in najbolj prepoznvanih metuljev v Evropi. Na Hrvaškem poseljuje obalne predele od Reke proti jugu Dalmacije in mnoge Jadranske otoke. Njegov habitat predstavlja grmovje in makija, kjer rase hranilna rastlina gosenic,* Arbutus unedo. *Do nedavnega je bilo njegovo pojavljanje na severozahodnem delu Hrvaške, na polotoku Istra, vprašljivo. Med leti 2008–2012 je bil dvorepi paša zabeležen na treh novih lokacijah v Hrvaški Istri: Paludu, Premanturi in Kalavojni. S temi najdbami sta potrjeni njegova prisotnost na istrskem polotoku ter njegova razširjenost v severozahodnem delu Hrvaške. Razširjenost dvorepega paše na Hrvaškem se v veliki meri prekriva z razširjenostjo hranilne rastline gosenic. Dolina reke Mirne verjetno predstavlja mejo dvorepega paše, saj nikoli ni bil najden severneje od nje, prav tako ne v Sloveniji. Zemljevid z vsemi objavljenimi lokacijami na Hrvaškem je prikazan.*

Ključne besede: *Charaxes jasius, Arbutus unedo*, Istra, razširjenost

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FIRST RECORD OF *DELEPROCTOPHYLLA AUSTRALIS* (FABRICIUS, 1787) (INSECTA: NEUROPTERA: ASCALAPHIDAE) IN ALBANIA

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ABSTRACT

The owlfly species, Deleproctophylla australis *(Fabricius) has been recorded for the first time in Albania. The species is Pontomediterranean – Balkan element expanding westwards. Some details concerning the morphology and habitat of the species are provided.*

Key words: Neuroptera, *Deleproctophylla*, new record, Albania

PRIMA SEGNALAZIONE DI *DELEPROCTOPHYLLA AUSTRALIS* (FABRICIUS, 1787) (INSECTA: NEUROPTERA: ASCALAPHIDAE) IN ALBANIA

SINTESI

La presenza di una specie di neurotteri ascalafidi, Deleproctophylla australis *(Fabricius), viene segnalata per la prima volta per il territorio albanese. Si tratta di un elemento Ponto-Mediterraneano – Balcanico, in espansione verso occidente. L'articolo riporta alcuni dettagli morfologici della specie, nonché le caratteristiche dell'habitat.*

Parole chiave: Neuroptera, *Deleproctophylla*, prima segnalazione, Albania

INTRODUCTION

Because of their large size, owlflies (Ascalaphidae) are one of the most attractive representatives of Neuroptera. The owlfly family comprises less than five hundred species, with the centres of distribution mainly in the tropics and subtropics.

In Europe there are 17 species, with 5 species in 3 genera occurring on the Balkan Peninsula (Aspöck *et al*., 2001; Pantaleoni *et al*., 2011). In his review summarising information on the owlflies of the Balkan Peninsula, Popov (2004) presented the distribution of the species without citation of some relevant previously published references (besides short reports, the following papers devoted to owlflies are missing; Devetak, 1998; Devetak *et al*., 2002).

The ascalaphid fauna of Albania was, until recently, poorly mapped, and only sporadic information on species occurence in the country existed (Pongrácz, 1923; Capra, 1945; Zelený, 1964; Popov, 2004). Popov (2004) listed for Albania the following three species: *Libelloides lacteus* (Brullé, 1832) (syn.: *L. ottomanus* /Germar, 1839/), *L. macaronius* (Scopoli, 1763) and *L. rhomboideus* (Schneider, 1845). In July 2012, zoologists from the University of Maribor (Slovenia) collected lacewings in southern Albania; here we report observations of *Deleproctophylla australis* in the mountainous region of the country during the course of this fieldwork.

D. australis is a medium-sized owlfly, clearly separated from the other two European species of the genus by a yellow-brown spot near the pterostigma on the forewings (Van der Weele, 1908; Aspöck *et al*., 1980). The species is zoogeographically characterised as a Pontomediterranean – Balkan element expanding westwards (Popov & Letardi, 2010).

MATERIAL AND METHODS

Owlflies were collected using a sweep net. The captured individuals were preserved in alcohol and deposited in the first author's collection. Insects were photographed under a Nikon SMZ800 stereoscopic zoom microscope with a mounted Nikon DS-Fi1 digital camera and processed using NIS-Elements F 3.0 software. Digital images captured on different focal planes were assembled using the Helicon Focus 4.62 Lite application.

RESULTS AND DISCUSSION

Ascalaphidae Rambur, 1842

Deleproctophylla australis (Fabricius, 1787)

Material examined:

Albania: between Berat and Këlcyra: Qafa e Gllavës, 850-902 m above sea level, N 40° 32.35′ E 20° 0.19′; 18. VII. 2012; 1♂, 1 ♀, F. Janžekovič leg. The head, thorax, wings and the tip of the abdomen of the male are shown in Figures 1-4. The female was observed to have one phyllum. In the male, the tip of the abdomen with ectoprocts is of a very characteristic form (Fig. 2). On the distal part of each ectoproct there is a short, medially-oriented process.

Habitat: The owlflies were found in dry meadows with sporadic trees and bushes of *Quercus*, *Juniperus* and *Spartium*. The pasturing of goats was noted in the vicinity of the meadows.

In this paper, the occurrence in Albania of the genus *Deleproctophylla* is described for the first time. Like the three owlfly species recorded in the country previously (Popov, 2004), *D. australis* seems to also be common in other Mediterranean countries bordering Albania (Aspöck *et al*., 2001).

Whilst the habitats of *D. australis* occurring in north-western parts of the Balkans (in Istria and Dalmatia) are characteristically rocky (Devetak, 1995), the habitat in Albania – meadows in Qafa e Gllavës – was devoid of rocks. This Albanian habitat (meadows devoid of rocks) provides the same ecological circumstances as that in Southern Italy and other locations in the Balkans (continental Greece in particular) in which this species has been reported (R. A. Pantaleoni, *pers. comm.*). The female collected in Albania possessed phyla similar to those of the fertilized females in other parts of the Balkan Peninsula (Devetak, 1995).

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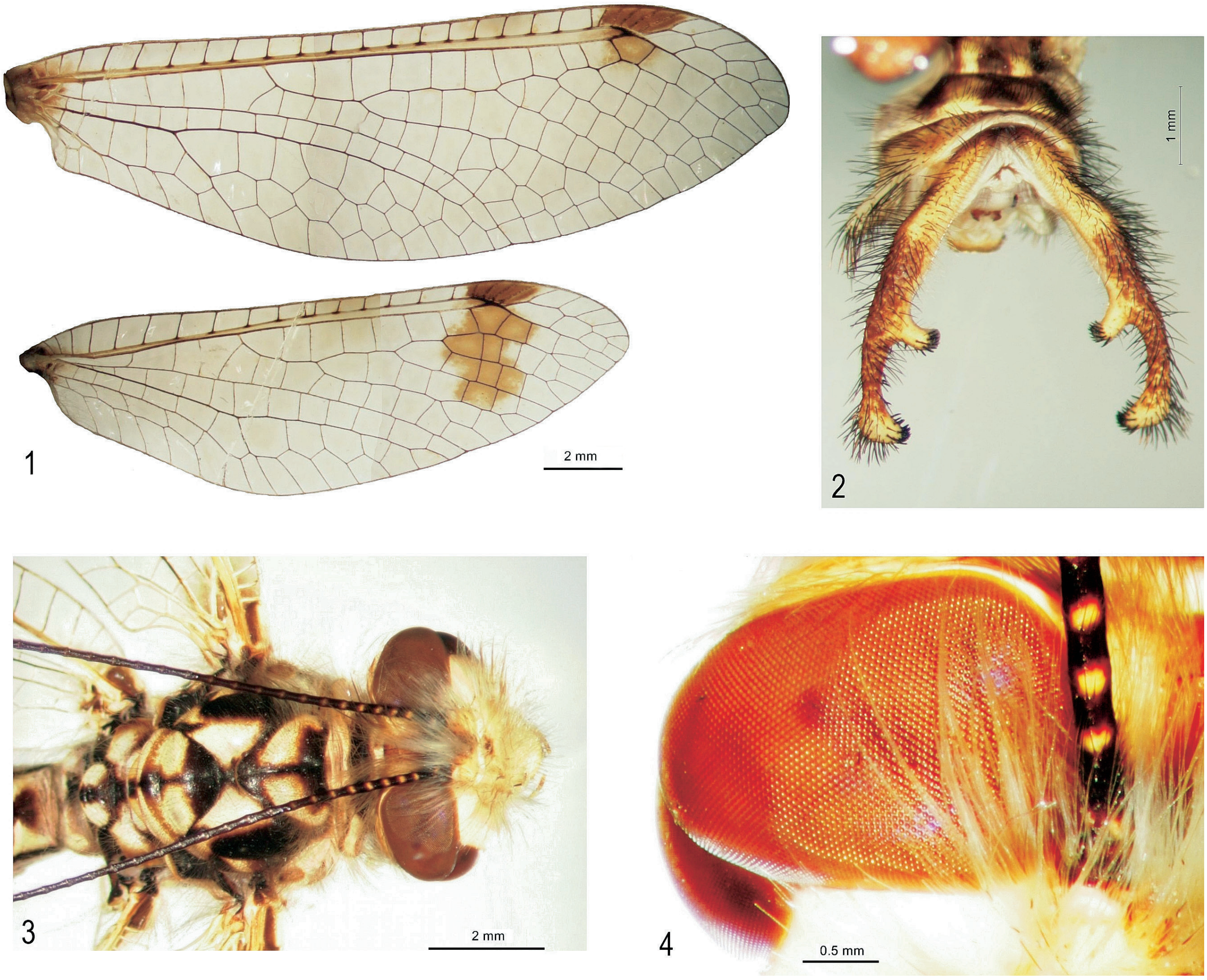

Figs. 1-4: *Deleproctophylla australis*, ***a male. 1 – wings; 2 – tip of the abdomen with ectoprocts; 3 – head and thorax; 4 – right compound eye.***
Sl. 1-4: Samec vrste *Deleproctophylla australis*. ***1 – krila; 2 – konec zadka z ektoprokti; 3 – glava in oprsje; 4 – desno sestavljeno oko.***

PRVA NAJDBA VRSTE *DELEPROCTOPHYLLA AUSTRALIS* (FABRICIUS, 1787) (INSECTA: NEUROPTERA: ASCALAPHIDAE) V ALBANIJI

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POVZETEK

Prvič je za Albanijo zabeleženo pojavljanje vrste metuljčnic Deleproctophylla australis *(Fabricius), ki predstavljajo pontomediteranski balkanski element s težnjo po širjenju na zahod. V prispevku podajamo slike kril, trupa, fasetnih oči in genitalnih segmentov samca ter opis habitata z juga Albanije. Živali smo nabrali na suhih travnikih, ob katerih pasejo koze. Vrsta se od drugih dveh evropskih vrst rodu* Deleproctophylla *razlikuje po temni lisi ob pterostigmi v sprednjih krilih. Za preiskanega samca so značilni parni ektoprokti, ki imajo v distalni polovici kratek izrastek, obrnjen medialno.*

Ključne besede: Neuroptera, *Deleproctophylla*, nova najdba, Albanija

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ASSESSMENT OF THE USE VALUES OF THE SEČOVLJE SALINA NATURE PARK (SLOVENIA)

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ABSTRACT

The establishment of the Protected Area and its management structure in the area of Sečovlje Salina (SW Slovenia) contributed both to economic development and to more effective biodiversity conservation. Provision of infrastructure and the introduction of programmes for visitors led to an increase in the number of visitors and corresponding income for the management of the park. Restoration of the traditional salt-making process resulted in the viable economic sustainability of the company to which the Republic of Slovenia delegated management of the Protected Area and offered the possibility for sustainable use of the natural resources within the area. From 2002 (when the park saw the introduction of active management and the re-emergence of traditional salt-making) to 2010, the employment increase index amounted to 421, while the visitors index grew to 360. What has to be highlighted is the fact that at the same time the park also witnessed growth in the population of endangered indicator bird species, an important biodiversity element whose conservation was the principal reason for the establishment of the protected area.

Key words: protected areas, Nature Park, sustainable tourism, economic valuation, salt-making, biodiversity conservation

Valutazione dell'uso dei valori del PARCO NATURALE delle Saline di Sicciole (SLOVENIA)

SINTESI

L'istituzione dell'Area Protetta e la struttura della gestione dell'area delle Saline di Sicciole (Slovenia sud-occidentale) hanno contribuito sia allo sviluppo economico che ad una più efficace tutela della biodiversità. La presenza di infrastrutture e l'introduzione di programmi per i visitatori hanno portato all'aumento del numero di visitatori e dei redditi correlati, fondi poi usati per la gestione del parco. La rivalorizzazione del processo di produzione tradizionale del sale ha inoltre portato alla sostenibilità economica della società alla quale la Repubblica di Slovenia ha delegato la gestione dell'Area Protetta, gestione che offre la possibilità di un uso sostenibile delle risorse naturali all'interno del bacino. Dal 2002 (quando nel parco è stata avviata una gestione attiva ed è stata riattivata la produzione tradizionale del sale) al 2010, l'indice d'incremento dell'occupazione è stato pari a 421, mentre l'indice del numero di visitatori è cresciuto fino a 360. Ciò che è inoltre da rilevare è che, allo stesso tempo, nel parco si è verificata una crescita delle popolazioni delle specie indicatrici minacciate dell'avifauna, elemento importante della biodiversità, la cui tutela è l'obiettivo principale dell'istituzione dell'area protetta.

Parole chiave: aree protette, Parco Naturale, turismo sostenibile, valutazione economica, produzione del sale, tutela della biodiversità

INTRODUCTION

The recognition of the socio-economic benefits of the protected areas is mostly based on the ecosystem services of the area (Millennium Ecosystem Assessment, 2005). Ecosystem services is the name given to the resources which nature supplies to humans; for example, biodiversity provides us with food, wood, textiles, fuel, medicines and clean water and also offers direct economic benefits for humans beings, such as earnings from tourism development (Secretariat of the Convention on Biological Diversity, 2008).

Protected areas are driving forces of economic development only insofar as the basic aim of their establishment, that is biodiversity conservation, is considered as the primary management goal and is not jeopardized by other activities in the protected area (Dudley & Stolton, 2008).

The concept of the evaluation of economic benefits of protected areas is based on the determination of the use values of goods and the values of non-use (Phillips, 1998; Slabe-Erker, 2005), with the latter usually being prevalent in protected areas. The use value may be indirect or direct. The direct use value of the protected area is the value of its constituent elements (*e.g.* wood, crops and plants, as well as autochthonous agricultural plants, breeds of domesticated animals, etc.); whereas the indirect use value, which is derived from protected areas with valuable natural features and biodiversity, is the ecological value that supports the functioning of society and the economy (*e.g.* various phenomena such as nutrient/oxygen/water cycling, carbon sink, protection against erosion, as well as educational, cultural, aesthetic, spiritual, recreational and other values, etc.; Slabe-Erker, 2005). The non-use values are option values (intangible and independent of use and non-use, and derived from the preservation of the area for future generations) and existence values, and are based on the premise that species and ecosystems exist by themselves and are rooted in human culture (Slabe-Erker, 2005).

The direct use value of a protected area is derived from activities such as recreation, tourism, natural resource harvesting, gene pool services, education, research, etc.

The aim of this paper is to evaluate the direct economic benefits of the establishment and effective management of the Sečovlje Salina Protected Area and to demonstrate that these benefits have not negatively affected the biodiversity values of the area.

DESCRIPTION OF THE AREA AND ITS MANAGEMENT

Covering a surface area of 6.5 km^2, the Sečovlje Salina is situated in the southwesternmost part of Slovenia, along the border with Croatia (Fig. 1). It is one of the few salt-pans in the Mediterranean where salt is still produced according to the several-centuries-old traditional method. The park features tangible remains of medieval and slightly modernised types of salt-pans.

Fig. 1: Geographical position of the Sečovlje Salina Nature Park (SSNP).
Sl. 1: Geografski položaj Krajinskega parka Sečoveljske soline (KPSS).

Being home to a number of rare and endangered salt-loving species and habitat types, the Sečovlje Salina is of great national and international importance, a fact which is also reflected in its protected status as assigned on the basis of Slovene (ZON, 2004; Berginc *et al.*, 2006) and European legal regulations and international conventions in the field of nature conservation (the Park has been declared a nature park of national importance, a Natura 2000 area, and a Ramsar wetland of international importance).

Sečovlje Salina has also been designated as being of extraordinary importance for its ethnological, technological, historical and architectural heritage and landscape, both at and beyond the national level. It is the convergence of its outstanding natural features and biodiversity with its salt-making tradition and cultural landscape that bestows upon it a special value in terms of nature and culture protection, making it an attractive tourist destination (Fig. 2).

The Sečovlje Salina Nature Park (hereinafter: SSNP) is managed by the company "SOLINE Pridelava soli d.o.o." (Soline d.o.o.). The concession agreement between the Republic of Slovenia and the company, delegated management of this Protected Area to the company together with the rights to utilise valuable natural features of Sečovlje Salina and to produce salt in a traditional manner. The concessionaire owns no real estate in the park. The real estate (land, dykes, salt-pans, buildings, etc.) is almost entirely owned by the Republic of Slovenia, with minor owners being the Municipality of Piran and a few private land-owners. There are no human settlements in the park.

Fig. 2: Aerial photo of the area. (Photo: SSNP Archives)
Sl. 2: Letalski posnetek obravnavanega območja. (Foto: arhiv KPSS)

Having gained the concession rights to manage the nature park and to produce salt, the company developed a new business vision based on the sustainable use of valuable natural resources and on the production of traditional, entirely natural Piran salt, as well as on active management of the nature park.

Within the park are several walking and cycling paths with a total length of 9.1 km (Fig. 3); a renovated building housing a large information centre for visitors, a miniature model of the salt-pans and a projection hall; small information points at the two land entrances to the park and in the gallery, which houses an exhibition area and a souvenir shop; a lookout platform, a demonstration salt pond for visitors, a café, toilets for visitors, a parking area in front of the entrance to the park, and several information boards. The park also boasts a salt-making museum. The entrance fee covers a visit to the park and the museum. The park can be visited individually and in groups. Group visits are always guided by the park's professional staff.

METHODS

An analysis of two indicators of the direct economic benefits brought about by the establishment and management of the protected area was undertaken measuring:

a) the increase in the number of visitors and, consequently, the income generated through entrance fees, and
b) the increase in direct employment generated by the traditional and environment-friendly use of natural resources (salt-making) and the active management of the protected area.

The increase in visitation was analysed on the basis of the number of tickets sold. There are two entrances to the park from the land, and tickets may be purchased at both. Visitors visiting the park by boat (organised tours only) also buy tickets. Entrance to and use of the Paren-

Fig. 3: Walking paths in the Sečovlje Salina Nature Park. (Source: SSNP Archives)
Sl. 3: Poti za obiskovalce v Krajinskem parku Sečoveljske soline. (Vir: arhiv KPSS)
Legenda/Legend: servisna pot = service road; kopenski vhodi in izposoja koles obiskovalcem (ureditev kolesarnice) = entrances by land and bicycle rental facilities (bicycle shed); območje privezov za obiskovanje parka = mooring area for visitors accessing the park by sea; pristajalni pomol = landing pier; pešpot = footpath; pot za vodene skupine = guided walking tour; kolesarska pot = cycle route.

zana Path of Health and Friendship that crosses the park is free of charge.

The increase in direct employment is evident from employment data (as of 31 December each year) kept by the Soline Company since 2002.

Regular monitoring of bird species is carried out as a part of the management activities in the park. Detailed monitoring of breeding and trends among some indicator bird species started soon after the establishment of the park and its managerial structure. The detailed monitoring methods are described by Škornik (2012).

RESULTS AND DISCUSSION

Increase in the number of visitors to the park

The development of sustainable tourism in the Protected Areas has been presented in several studies (*i.e.* FNNPE, 2001; EUROPARC, 2012). Sustainable tourism development is a subject of analyses in the wider SSNP area (*e.g.* Jurinčič, 2009; Jurinčič & Popič, 2009), as well as for the site with which we are presently concerned (Trampuš, 2002). The number of visitors to the SSNP has been increasing owing to diverse infrastructure (walking and cycling paths, signs, information boards, visitor centre, etc.) and a variety of programmes offered to visitors and tourists (guided tours, "team-building", yoga and Pilates, workshops, events, exhibitions, etc.). As a result, the park has witnessed an increase in self-generated income, which is subsequently earmarked for park management, and especially for setting up and maintaining infrastructure. The number of visitors and annual visitation trends for the SSNP are shown in Table 1.

We see that the number of visitors is 3.6 times greater than it was when active management of the park was first undertaken. The table and the diagram do not include users of the Parenzana Path of Health and Friendship as they are exempt from paying the entrance fee.

The above-mentioned self-generated income, together with individual donations and international funding through projects in which the park administration is involved either as a project partner or leader, account for approximately 75% of the financial resources necessary for the park's management, meaning that the founder of the Protected Area (the Republic of Slovenia) provides only approximately one quarter of the total funds.

Direct employment increase in the park

After WWII, traditionally produced salt, which used to be the engine of the regional economy, became an uncompetitive commodity in the European and local markets owing to the invasion of salt produced at low cost along the African coast and in European salt mines. This period witnessed the decline of several dozen traditional salt-pans in the northern Mediterranean. Sečovlje Salina saw the abolition of salt-making at Fontanigge (the southern part of the park) in 1967, while salt-making at Lera (its northern part) was mostly stagnating until the new owner, the "Soline d.o.o." Company, took it over in 2002. The dykes were poorly maintained, the salt-pans were mostly abandoned, and the buildings, designated as architectural heritage, were mostly severely dilapidated, with some of them even being in complete ruins. At

Tab. 1: Total number of visitors and their monthly distribution between 2002 and 2010. Source: SSNP Archives.
Tab. 1: Skupno število obiskovalcev in njihova razporeditev po mesecih med letoma 2002 in 2010. Vir: arhiv KPSS.

Month	Year								
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
January				542	410	526	406	794	580
February				878	766	853	802	681	654
March				1,286	1,211	1,579	1,509	1,094	1,142
April				1,711	2,125	2,770	1,568	2,370	4,377
May				1,692	4,529	4,617	3,726	4,682	3,373
June				1,310	6,209	4,789	2,789	3,806	4,365
July				1,714	1,993	2,927	1,846	2,422	2,309
August				2,367	2,791	2,177	1,957	1,693	3,107
September				2,084	4,674	4,064	3,007	4,585	4,266
October				1,706	3,990	4,709	2,405	4,097	3,050
November				1,236	2,373	1,450	1,180	1,224	1,030
December				454	351	917	264	653	590
TOTAL	**8,000***	**20,000***	**25,000***	**16,980**	**31,422**	**31,378**	**21,459**	**28,101**	**28,843**

**** The number of visitors in 2002, 2003 and 2004 is based on estimations. In other years, it is based on the number of sold entrance tickets.***

Fig. 4: Two lines of products launched by the Sečovlje Salina Nature Park. (Source: SSNP Archives)
Sl. 4: Blagovni znamki in proizvodi iz Krajinskega parka Sečoveljske soline. (Vir: arhiv KPSS)

that time, the company employed only a few salt workers still skilled in the unique traditional salt-making technique based on the cultivation of *petola* (a special biosediment) and daily salt harvesting in summer months. The experienced salt workers believed that, owing to poor maintenance of the salt-making infrastructure, it would take only a year or two for the sea to break down the dykes and flood the salt-pans.

The Soline Company decided to resurrect the traditional salt-making procedure in order to promote conditions favourable to biodiversity and diverse habitat types, and thus find a niche market. With this in mind it renovated more than twenty-five salt ponds, a number of dykes totalling several dozen kilometres in length, more than ten structures with the architectural heritage designation, the most important infrastructure (including the sewage system, which had to be built from scratch) and several smaller structures and machines. The company launched two lines of products related to traditionally harvested salt and salt-making by-products, both of which managed to penetrate the Slovene and foreign markets, and opened six of its own stores in different locations in Slovenia (Fig. 4).

Table 2 shows the increase in the number of employees of the company that manages the park and which was granted a license to produce salt in the SSNP. Data refer to the years 2002–2010. In 2010, 21 positions were occupied by staff in charge of park management, while the rest were taken by people in salt-making, water management, maintenance, administration and marketing. Indirect employment (seasonal and contract workers) has not been evaluated yet, even if it certainly ranks high, exceeding the number of full-time employees several times over (during the salt harvesting season, the number of seasonal workers alone amounts to several dozen).

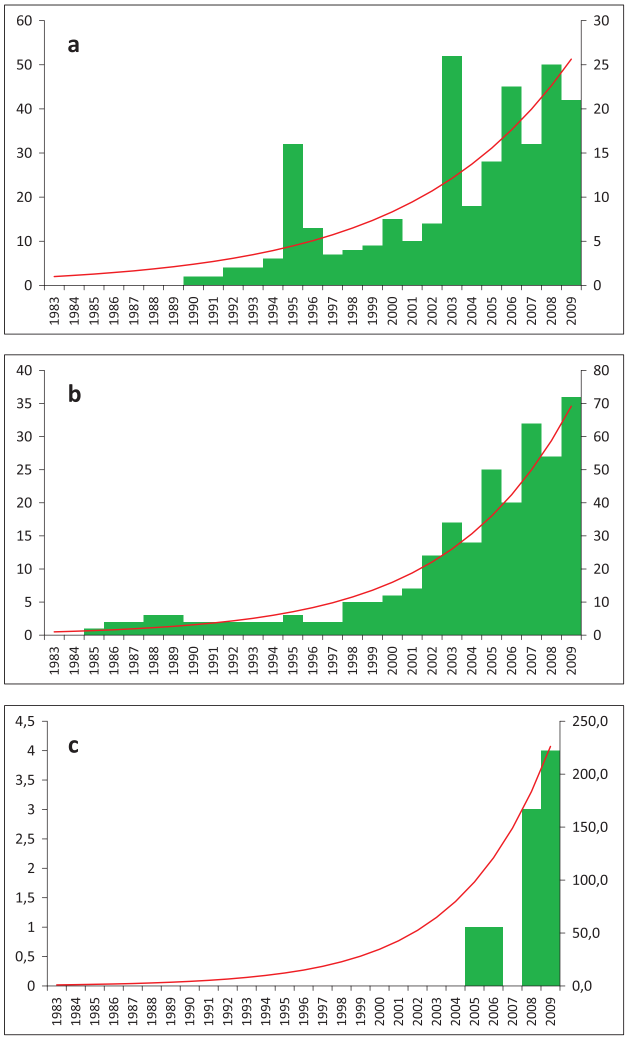

Fig. 5: Trends among indicator bird species in Sečovlje Salina, 1983-2009: a) black-winged stilt; b) little tern; c) avocet) and the increase in the number of its nesting pairs. Legend: bars = no. of nesting pairs, red line = trend (modified after Škornik, 2012).
Sl. 5: Trendi značilnih vrst ptic Sečoveljskih solin v obdobju 1983–2009. a) polojnik; b) mala čigra; c) sabljarka. Legenda: stolpiči = število gnezdečih parov, črta = trend (prirejeno po Škornik, 2012).

The employment increase index in the SSNP amounted to 421 in recent years, making the company, responsible as it is for the management of the park and the sustainable use of the natural resource within it, one of the most important job providers in the wider local area.

Tab. 2: Increase in the number of employees of the Soline Company between 2002 and 2010. Source: SSNP Archives
Tab. 2: Rast števila zaposlenih v podjetju Soline med letoma 2002 in 2010. Vir: arhiv KPSS.

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
No. employees as of 31 Dec	19	35	44	48	48	47	52	57	80

Changes in the number of indicator nesting bird species

Despite the revival of the traditional salt-making technique and the increased number of visitors to the park, the number and distribution of selected indicator birds species nesting in the salt-pans (Fig. 5) has been increasing as a result of the implementation of the protective regime, management interventions, and the concept of conation, according to which visits and salt-making are limited to specially designated areas. The increase has also resulted from the strict protection of zones of invaluable natural importance where a special water regime, adapted to the local flora and fauna and habitats, was implemented. The population of typical saline nesting birds such as the Black-winged Stilt and Little Tern has grown by almost 500 and 300 per cent respectively in the observation period from 2002 (the start of effective management of the park) until 2009.

Since the introduction of active management, several new nesting species have also been observed (such as the avocet, Fig. 5c).

This period also witnessed a considerable increase in the number of all birds observed in the park (Fig. 6). The efforts to conserve biodiversity are also reflected in the increase in the amount of time spent by SSNP employees on monitoring selected natural factors in the park.

CONCLUSIONS

Having been established in order to conserve nature, protected areas are among the most important aspects of ecosystem services that humanity needs in order to survive. In Slovene protected areas, the value of such services has not been determined as yet. The case study of the SSNP evaluated the direct socio-economic benefits of the protected area: the increase in the amount of direct employment in the company managing the protected area and in the number of employees involved in the traditional use of natural resources (salt-making process), and the increase in ticket sales.

From 2002 (when the park saw the introduction of active management and the revival of traditional salt-making) to 2010, the employment increase index in the SSNP was 421, while the visitation index rose to 360. Of

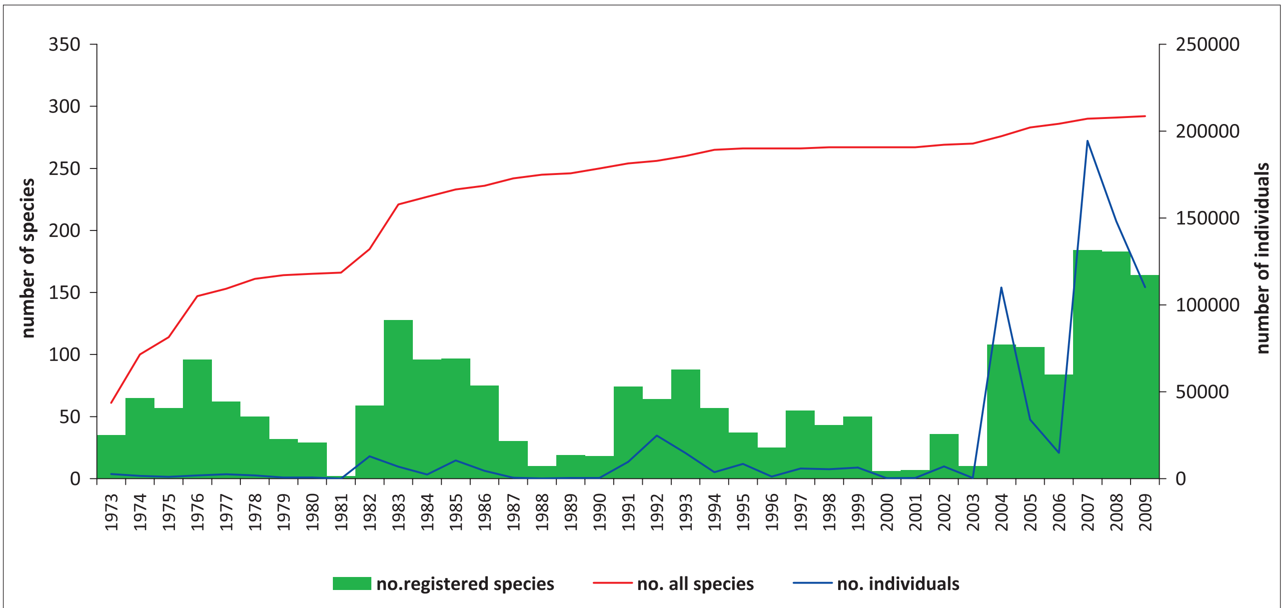

Fig. 6: Number of observed species and specimens per year and increase in the number of all observed species in the Sečovlje Salina Nature Park, 1973-2009 (modified after Škornik, 2012).
Sl. 6: Število evidentiranih vrst in osebkov po letih ter naraščanje števila vseh opazovanih vrst v obdobju 1973–2009 v Krajinskem parku Sečoveljske solin (prirejeno po Škornik, 2012).

particular significance is the fact that at the same time the park also witnessed growth in the population of endangered indicator bird species, an important biodiversity element whose conservation is the primary purpose of the protected area.

Moreover, local residents benefit from the higher quality of life resulting from the ecological services within the protected area, such as favourable microclimate, low levels of noise and pollution, opportunities for spiritual relaxation and passive recreation, and better knowledge of the area's biodiversity. Direct benefits are also derived from services offered to park visitors (*e.g.* restaurants and accommodation outside the park, direct employment in the park, indirect employment in the forms of delivery of services in natural science education, security, transport, maintenance, sale of local products produced in the park, etc.). The continuation of traditional salt-making, which has helped to shape the area and preserve its ecological character and landscape, enables local residents to live in harmony with the protected area and gives them the opportunity to participate in the seven-hundred-year-old salt-making procedure.

OVREDNOTENJE UPORABNE VREDNOSTI ZAVAROVANEGA OBMOČJA SEČOVELJSKE SOLINE

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POVZETEK

Ustanovitev zavarovanega območja in upravljanje s Krajinskim parkom Sečoveljske soline sta prispevala k ekonomskemu razvoju in bolj učinkovitemu varstvu biotske raznovrstnosti. Ureditev in vzdrževanje infrastrukture za obiskovanje parka in ponudba programov za obiskovalce parka so posledično prispevali k povečanju števila obiskovalcev parka, ki s plačilom vstopnine prispevajo sredstva za upravljanje parka. Obnova tradicionalnega postopka pridelave soli je prispevala k trajnostni rabi naravnih virov in povečanju prihodkov za podjetje, ki mu je država prek koncesijske pogodbe zaupala upravljanje z državnim zavarovanim območjem in omogočila izkoriščanje naravnih virov. Od leta 2002, ko se je pričelo z aktivnim upravljanjem s parkom in obnovo tradicionalnega postopka pridelave soli, do leta 2010 se je indeks števila zaposlenih povišal na 421, indeks števila obiskovalcev parka pa na 360. Posebej pomembno je, da se ob tem še vedno povečujejo populacije ogroženih indikatorskih ptic gnezdilk, ki so pokazatelj ugodnega ekološkega stanja za doseganje osnovnega cilja ustanovitve zavarovanega območja, to je ohranitve biotske raznovrstnosti območja.

Ključne besede: zavarovana območja, krajinski park, trajnostni turizem, ekonomsko ovrednotenje, solinarstvo, ohranjanje biodiverzitete

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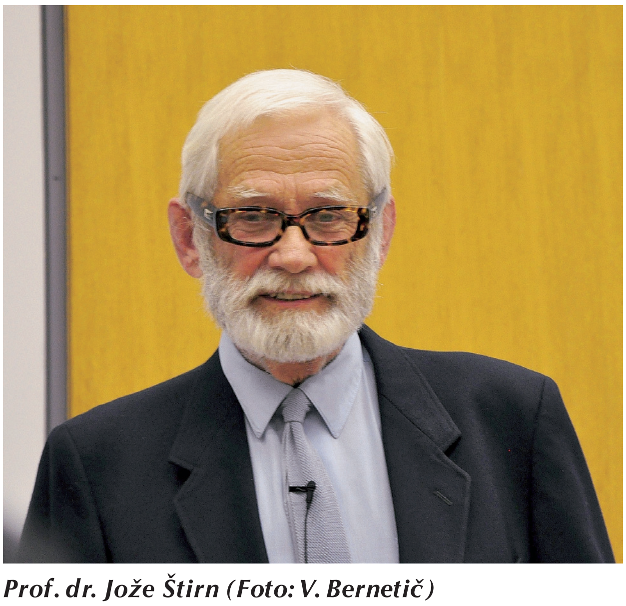
PROF. DR. JOŽE ŠTIRN, DOBITNIK NIB-OVE NAGRADE ZA ŽIVLJENJSKO DELO

Prof. dr. Jože Štirn se je z raziskovanjem začel ukvarjati že kot študent biologije in je za svoje delo prejel kar tri Univerzitetne Prešernove nagrade. Kmalu je svojo naravoslovno radovednost povezal tudi z organizacijskimi sposobnostmi in v letih 1960–61 organiziral in vodil prvo jugoslovansko biološko ekspedicijo v Etiopijo in na Rdeče morje. Odmevnost odprave in sodobna potapljaška oprema, ki so jo darovale tuje firme in Splošna plovba Piran, sta mu omogočili, da je leta 1962 osnoval Republiški center za podvodna raziskovanja v Ljubljani in Potapljaško šolo v Fiesi. Že dve leti kasneje pa je z odobritvijo soustanovitelja SAZU dosegel ustanovitev in uradni znanstveni status Zavoda za raziskovanje morja Slovenije v Portorožu, katerega direktor je bil v letih 1964–1967. Zavod je bil nato ukinjen, njegove prostore pa je leta 1969 odkupil Inštitut za biologijo Univerze v Ljubljani za potrebe na novo ustanovljene Morske biološke postaje v Portorožu kot samostojne enote Inštituta. Prof. Štirn se je postaji pridružil leta 1970 in jo do leta 1977 tudi vodil. V tem času je pod okriljem UNESCa organiziral podiplomske tečaje mediteranske morske ekologije za slušatelje iz sedemnajstih držav Sredozemlja. Na osnovi njegovih odmevnih znanstvenih objav iz tistega obdobja sta mu Okoljski program in Organizacija za hrano in kmetijstvo pri Združenih narodih poverila pripravo projekta mediteranskih raziskovanj ekoloških vplivov morskega onesnaževanja s sedežem programa v Alžiru. Vse to je bistveno prispevalo k še vedno trajajočemu sodelovanju Morske biološke postaje v mediteranskih projektih teh organizacij, financiranju dragocene raziskovalne opreme in štipendiranju sodelavcev MBP v tujini. Prof. Štirnu je kasneje uspelo pridobiti nove prostore za postajo in jih preurediti v sodoben morski raziskovalni center. S tem je prof. Štirn zaslužen ne le za razvoj Morske biološke postaje, temveč tudi za mednarodni ugled ustanove, ki danes deluje kot organizacijska enota Nacionalnega inštituta za biologijo.

Še v času delovanja na Zavodu za raziskovanje morja je na osnovi svojih raziskav postavil hipotezo o vplivu reke Pad na evtrofikacijo tega območja. Ta je bila potrjena mnogo kasneje na osnovi številnih satelitskih posnetkov porazdelitve klorofila-a in porazdelitve površinske temperature, skupaj z numeričnimi simulacijami cirkulacije tega območja. V šestdesetih letih preteklega stoletja je proučeval tudi vpliv komunalnih odplak na ekološke razmere v morju ter na fitoplanktonske in zooplanktonske karakteristike severnega Jadrana, kar je v letu 1966 zaključil s smernicami za obravnavo in vodenje odplak s podmorskimi izpusti izven obrežnega pasu, ki jim je sledila občina Piran. Ob koncu šestdesetih let se je prof. Štirn zaposlil na Smithsonianovem inštitutu v Washingtonu v ZDA za delo na Projektu flore in favne Sredozemskega morja. V okviru projekta je v Tuniziji vodil oddelek za bentoške nevretenčarje sredozemskega in rdečega morja, z raziskavami evtrofikacije velike morske lagune v Tunisu. Iz lagune je izoliral in nato gojil različne alge, ki povzročajo evtrofikacijo. Izolat ene od njih je poslal v zamenjavo nekaterim specialistom, od njih pa je brez njegove vednosti oz. dovoljenja zašla v ribogojnice morskih rib. Od takrat se še vedno uporablja v industrijskih ribogojnicah kot živa hrana ribjih ličink. Za delo Ecological Consequences of Marine Pollution je leta 1972 prejel nagrado Sklada Borisa Kidriča.

Prof. Štirn se je v začetku osemdesetih let zaposlil pri medvladni komisiji za oceanografijo pri UNSECU z večletnimi misijami v tedanji Demokratični republiki Južni Jemen, Severnem Jemnu in v Kamerunu. Kot redni profesor je v osemdesetih letih na Oddelku za biologijo Biotehniške fakultete poučeval oceanografijo, ekologijo morja in ribiško biologijo. Med letoma 1988 in 1990 je bil profesor na Univerzi v Nici, nato pa je prevzel odprto profesuro na Univerzi Sultan Qaboos v Omanu, kjer je kot svetovalec načrtoval in upravljal tamkajšnji nacionalni program ribištva in sodeloval na ekspedicijah raziskovalnih ladij v Indijskem oceanu in v Perzijskem zalivu. Zbral je množico planktonskih vzorcev, ki jih še danes zavzeto obdeluje, v sklopu projekta Tethys pa pripravlja monografijo in atlas planktonskih alg Sredozemskega morja, Indijskega oceana in obrobnih morij. Od leta 1997 do nedavnega je predaval na Université Internationale de la Mer v Cagnes-sur-mer, ki mu je leta 2002 podelila naziv zaslužnega profesorja. Od leta 1992 je dopisni član Evropske akademije za okoljske zadeve v Tübengenu. Prof. Štirn ni človek, ki bi v pokoju miroval. Že od leta 2005 vodi projekt o vplivih delovanja Luke Koper na onesnaževanje in druge okoljske probleme v Koprskem zalivu.

Prof. dr. Jože Štirn je strokovnjak izredno širokega pogleda, naravoslovec v polnem pomenu besede, potapljač, ribič, limnolog in oceanograf, predvsem pa



Prof. dr. Jože Štirn (Foto: V. Bernetič)

morski ekolog. Že zgodaj je spoznal, da lahko biologijo morja razumemo le, če njene raziskave povezujemo tudi z oceanografijo, limnologijo, kemijo in mikrobiologijo morja. Tako je v slovenski prostor postavil zametke iz opisne oceanografije, vpeljal je marikulturo, podal osnove za raziskave v ribištvu ter postavil temelje za kasnejše specializirano raziskovalno delo na posameznih segmentih morske ekologije. S številnimi prispevki v poljudno-znanstvenih revijah in dnevnem časopisju je pomembno prispeval k osveščanju slovenske javnosti v zvezi z onesnaževanjem morja, opozarjal pa je tudi na njegovo bogastvo. Njegovi prispevki so navdušili številne kasnejše strokovnjake s področja morskih ved za izbrano strokovno pot.

Vlado Malačič, Jadran Faganeli in Janez Forte

DELA NAŠIH ZAVODOV IN DRUŠTEV, 199–201

1st INTERNATIONAL SCIENTIFIC MEETING IN THE SEČOVLJE SALINA

Sečovlje Salina is an exceptional locality in the Slovenian and Mediterranean area and is known for its immense biodiversity (ornitofauna, halophytes, rare & endangered species, outstanding diversity of habitat types) and important natural and cultural heritage, including natural salt production in the traditional manner. For decades Sečovlje Salina has attracted the attention of scientists from different fields such as chemistry, biochemistry, microbiology, geology, pharmacology and others. Today, at a time of global and rapid devastation and even loss of Mediterranean Salinas and coastal wetlands as well, Sečovlje Salina represents a successful model of symbiosis between the conservation of outstanding biodiversity and the cultural heritage and traditional use of the natural resources found within Sečovlje Salina Nature Park. Comparable trends are observed also for other similar environments.

Transmission of new knowledge, exchange and dissemination of best practices, ideas for innovative approaches to sustainable development, and other important dialogues among scientists across disciplines and across methods, all usually transpire during joint seminars. The idea behind our intention to combine diverse knowledge covering all aspects of the scientific and professional activities involved in Salinas and similar wetlands prompted us to organize a start-up multidisciplinary meeting. Therefore, the first international meeting entitled "Sečovlje Salina as a Scientific and Educational Basin" was held on October 5th, 2012 in the multimedia hall at Sečovlje Salina Nature Park. It was hosted by the Marine Biology Station of Piran (National Institute of Biology) in collaboration with the company SOLINE Pridelava soli d.o.o. and Sečovlje Salina Nature Park, with the financial support of the Slovenian Research Agency and Slovenian National Commission for UNESCO.

The meeting began in the morning with opening remarks by Klavdij Godnič (Director of SOLINE Pridelava soli d.o.o.), Prof. Dr. Tamara Lah Turnšek (Director of the National Institute of Biology Ljubljana), Marjutka Hafner (chief executive of the Slovene office for UNESCO), Assoc. Prof. Dr. Vlado Malačič (head of the Marine Biology Station), Dr. Andrej Sovinc (Head of Sečovlje Salina Nature Park), Prof. Dr. Lovrenc Lipej (chairman of the organizing committee) and Dr. Peter Bossman (Mayor of Piran), the latter of whom gave the welcome speech. More than 60 scientists and experts from Slovenia, Croatia and Italy gave excellent speeches and poster presentations about different studies performed in Salinas and similar environments. Research topics presented in plenary lectures and posters and also published in the book of abstracts included:

- the main scientific research and new results about Sečovlje Salina, including flora, vegetation, sedimentology, biogeochemistry and biodiversity of fungi and yeasts,
- the scientific research activities and conservation efforts of Salinas and other Adriatic coastal wetlands like Val Canavata, Comacchio Saltworks, Marano and Grado Lagoon, Škocjan Inlet Nature Reserve, Strunjan Lagoon, Makirina Bay, and WWF Nature Reserve Salinas of Trapani and Paceco,
- traditional salt production in Sečovlje Salina (based on the petola microbial mat) and other healing by-products from the saltpans (brine, saline mud-fango) and their role in the development of tourism (thermal and wellness) in Portorož,
- innovative algal technology for the revitalization of Salinas based on sustainability and renewability,
- historical data about salt harvesting in Sečovlje during the Maunder Minimum.

In conclusion, the importance of cooperation among all professionals as well as other entities/participants was stressed. The participants at the meeting also recognized the need for the continuous sharing of new information, so we hope to repeat the meeting in two years' time.

Neli Glavaš and Nives Kovač